THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXXIV., No. 13. Whole No. 1,607. | NEW YORK, MONDAY, MARCH 26, 1906. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 42 Pine Street, New York.

Telephone.—2996 John.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

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[OFFICIAL NOTICE.]

Annual Meeting, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
March 20th, 1906.

To the Members of the Western Gas Association: The next meeting of the Western Gas Association will be held May 16, 17 and 18, as declared by the executives.

JAS. W. DUNBAR, Secretary.

BRIEFLY TOLD.

TWENTY-SECOND ANNUAL MEETING, OHIO GAS LIGHT ASSOCIATION.—"The meeting this year of the Ohio Gas Light Association was brought off, according to programme, in the Assembly Hall of the Grand Hotel, Cincinnati, O., on the appointed days, March 21st, 22d and 23d. President Donald McDonald conducted the proceedings in an orderly fashion, even though his home is in Louisville, Ky. The attendance was a record one, but some of the remarks made by the Mayor of the city, Mr. E. J. Dempsey, in his address of welcome, were not as warmly received as his admirers in the gas business would wish. However, Mr. John D. McIlhenny rather evened the tables in his reply. Of course, both of these speeches will appear later on in the right report. The programme, as detailed heretofore in the JOURNAL was followed out religiously, and the plan for joining in the amalgamation as proposed by the American Gas Association was adopted without dissent, as we all knew it would be. The general business of the sessions was attended to with carefulness, the paper discussions were well extended and interesting, and the report of the committee on uniformity in gas meters is sure to create comment. The nature and performance of the work done by the Committee on Entertainment, could not be exceeded; and put me down as saying that Mr. T. C. Jones is 'all to the good.'—W."

DEATH OF MR. THOMAS CURLEY.—With great regret we announce the death of Mr. Thomas Curley, for many years Superintendent of the Wilmington (Del.) Coal Gas Company, and a member of the American Gas Light Association since October, 1879. He was born in Roscommon, Ireland, in 1830, and came to America in 1848. In 1851 he was appointed Superintendent of the Wilmington (Del.) Coal Gas Company, in which position he remained until 1903, when he was succeeded by his son. He is survived by his widow and seven children. He was a man of sterling character, and will long be pleasantly remembered by his associates.

NOTES—

WE are indebted to the proprietors of the Pittsburgh Meter Company, of East Pittsburgh, Pa., for a copy of its new catalogue, which certainly does justice to the taste of its compilers and its printers.

"A. S.," writing from Webster, Mass., under date of the 16th inst., said: "Down has dropped the price of gas and electricity here, for at a recent meeting of the Directors of the Webster Electric Company it was

SMITHSONIAN DEPOSIT.

decided to reduce the price of illuminating gas 15 cents per 1,000 cubic feet, and of electricity 4 cents per kilowatt, with still another cent off for prompt pay. The reduction of price is of a voluntary nature, and the action taken now has been under consideration since January 1. In addition to this action comes knowledge of the fact that the Webster Electric Company plans, as soon as it can do so, to still further reduce the price of illuminating gas. The present reduction, however, will be a big help to consumers, and it is a matter of much commercial importance in Webster. The present scale of prices for illuminating gas in Webster is $1.85 gross, and $1.75 net, per 1,000 cubic feet, and this announcement means notably a cut of 10 cents. The present price of electricity is 20 cents per kilowatt. Under the reduced scale the price will be 16 cents per kilowatt, a reduction of 4 cents, or 20 per cent., and in all cases where prompt payment is made, the price per kilowatt will be 15 cents, a reduction of 25 per cent."

Unlawful Persuasion in Cases of Strike.

The *Iron Age* says that the National Founders' Association has issued in the form of a pamphlet of 32 pages the brief of its attorneys in the Cincinnati case of the Iron Molders' Union of North America, *et. al.*, plaintiffs in error, versus the I. & E. Greenwald Company, defendant in error. The original action was an injunction proceeding brought by the defendant in error against the plaintiffs in error in the Superior Court at Cincinnati. The injunction restrained the Iron Molders' Union, its officers and others from obstructing the business of the I. & E. Greenwald Comyany, from picketing the sidewalks, streets and approaches adjacent to the plant, also from compelling or attempting to induce by intimidation, persuasion, force or violence any of the employees of the I. & E. Greenwald Co. to refuse to do their work or discharge their duties as employers. On August 14, 1905, charges of contempt were filed against John F. O'Leary, Vice-President of the Iron Molders' Union, and Henry Hinnenkamp, business agent of the union, reciting that they had violated the temporary injunction of the court by inducing two employees of the I. & E. Greenwald Company to break their contracts and leave the company's employ. They were each sentenced to pay a fine of $100 and give a bond in $500 to obey the injunction.

The defendants began proceedings in error, and the brief just published is the argument of the attorneys for the National Founders' Association, which had been conducting the strike for the I. & E. Greenwald Company. The bulk of the authorities cited in the brief bear on the question whether unlawful persuasion was involved in the case of the two officers of the union. The cases cited represented a variety of decisions in State courts as well as in Great Britain and in United States courts. A special citation is made of the famous Taff Vale decision given by the House of Lords. A quotation appears also from the findings of the Anthracite Coal Strike Commission. The brief says:

From these cases it evidently follows that inducing employees to break their contracts with employers by persuasive language, money consideration, etc., is an unlawful interference with the conduct of the business of the employer and is a violation of a property right. The facts as presented to the court clearly bring this case within the general rule recognized in all the cases above cited. The acts of the defendants Hinnenkamp and O'Leary were in direct violation of the order of injunction as that order must be construed in the light of the numerous authorities, a few of which only have been cited in this brief.

The conclusions drawn by the attorneys for the National Founders' Association are stated as follows:

The right of workingmen to give up their jobs singly or in a body is not the question at issue. The freedom of speech is not assailed. It is the abuse of the freedom of speech to accomplish an unlawful act—the carrying out of a combination for the unlawful purpose of injuring the business of another that is involved. The right to manage one's own business in one's own way without interference by others is fundamental in a free Government. The enforcement of the law can never be hostile to the true interests of the workingman; and those men who teach and preach that in some mysterious way the assertion of the basic principle of our institutions is to be regarded as an oppression of the workingman are not the friends but the worst enemies of labor.

The proposition that a combination to inflict injury upon another wrongfully is unlawful goes back almost to the beginning of our system of law. It will be a part of that system as long as freedom of contract and the liberty of the individual last. Such a combination of capital to restrain trade tends to establish monopoly and to oppress the public; such a combination of labor to inflict injury upon business and to deprive other men of the right to work strikes at the foundation of personal liberty.

[Official Report.—Revised by the Secretary.—Continued from Page 489.]

THIRTY-SIXTH ANNUAL MEETING, NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

Held at Young's Hotel, Boston, Mass., Feb. 20 and 21, 1906.

First Day—February 20—Morning Session.

A Telegram.

The Secretary—A telegram to the President reads:

Col. F. S. Richardson, President: Regret absence. In spirit, however, I am with you and the other lovely friends.—C. M. Higgins.

The President—Mr. Charles M. Higgins, of the Standard Oil Company, whom we all know. I will personally say that I am very glad to be remembered in this way by Mr. Higgins, and I am exceedingly sorry to know that he cannot come. I think everyone would enjoy his being here—I know I would; but the telegram speaks for itself.

And a Dip.

There may be time between this and adjournment to consider new questions. The first is "Naphthaline?" with a query after it. We might embrace the two:

"What is a quick method of determining the amount of naphthaline in gas?"

This is wide open to the whole Association, and those who know want to say so quickly. It may take a long time for discussion. It is important, it is new, and it will excite interest I know. There seems to be no waiting line, but some one ought to take first place. This old friend seems to be neglected. Mr. Quinn, of Newport, R. I., has had experience—not that others have not—but he is here.

Mr. Quinn—In October last, after 20 years' fighting with it, one thing I tried was oil. Simple! But I will tell you the conditions before I used the oil. I never have had any naphthaline in my works at all; simply at the inlet and the outlet of the holder. Now, previous to the first day of October, our governor had to be washed out twice a a day, either with naphtha or hot water, and the outlet drip of the holder would have to be pumped out twice a week. The quantity of condensation taken out of the outlet holder was about 60 gallons of water a week. I have no doubt that the pipe in the holder was almost closed with naphthaline, for the reason that during the time of my heaviest output my governor valve would go wide open. The holder I had to weight down by 7 tons of iron to get 3.6; still it would not supply the gas. The governor valve was down 4 inches, wide open, and yet the pressure at the inlet of the governor would be reduced .7 of an inch, or get down to 2.8, the pressure of the holder being 3.6 inches, the pressure at the inlet of the governor being 2.8 inches. It was the first time in 20 years that I had a public complaint at Newport about the quality of gas due to the pressure. Of course, I tried everything. On this Monday morning I had what they call cold test, or ammonia oil, that is, a lubricating oil which I used in another part of the works, which would not emulsify or solidify—emulsify probably—under low temperature; that is, it would retain its lubricating qualities at a temperature of zero. I fortunately had some of that on hand, and on this Monday morning I put 250 gallons inside of the holder, on top of the water. Monday night I had no trouble with my governor. Tuesday morning I had no trouble with my governor. I opened the governor on Tuesday to see what the condition was, and there was not a trace of naphthaline there, and since the second day of October I have not seen a trace of naphthaline at the governor. Meanwhile I noticed the opening of the governor. My day pressure before using the oil, when I was sending out probably 90,000 to 100,000 feet a day, the opening of the valve would open ¼ of an inch in the gauge, and that Monday, or, rather, Tuesday morning, it opened just ½ of an inch and gave constant pressure. In the evening, putting on the night pressure, it opened ¾ of an inch, giving the full holder pressure, of course, showing that the outlet pipe of the holder had been filled with naphthaline. Then again, after getting such good results there, I thought I would go backward. From the inlet pipe of the holder I got just the amount of water that was absorbed by the gas in passing through the meter, being deposited in the inlet pipe of the holder. Of course, I pumped that out of the drip twice a week to get rid of the condensed water. I used thousands of gallons of naphtha to dissolve the naphthaline in the pipes. Then I went back, drew the meter down, and put about 75 gallons of oil in the meter, and had the same result at the inlet of the holder—no naphthaline. Having just a little bit of a works we can do

anything, you know. We can simply by-pass the coal gas up to the water gas holder, shut off the meter or do anything we want to. Just previous to that time I opened this inlet pipe to the holder, and took out about 4 bushels of naphthaline. After running the meter with oil in it for, say, 2 months, I think the oil got broken up, or the globules were smaller, and the water in the meter was taken up by the gas, and we were getting a small quantity of water and naphthaline again in the inlet and the drip. About 10 days ago I drew off the water, and put in a lot more heavy oil. I thought in the beginning that any oil would do; but any oil won't do. I put in Texas oil, such as is used in some water gas, and found that was emulsified or broken up in small globules much easier than the heavier oil, which we call ammonia oil. Since putting in that oil our condensation ceased at the inlet. I will also say that since the 8th day of October we have not pumped 2 gallons of water out of the outlet drip, neither have we had any naphthaline. Of course, after such experiences I made some experiments on temperatures at the top of the holder, but I do not know whether I have them with me. All those things I did not take any record of, because when a man gets out of trouble he doesn't care; his trouble is behind him, not before him. Such is the way I looked at it, but I did this at the time for my own satisfaction. After finding out what results I had gotten from the use of oil on the top of the holder, I put a thermometer, which I had used in reading temperatures in an ice making plant, one made especially for low temperatures, and put that in the top of the holder, having an opening there, and took the following temperatures on October 3d. After finding and stopping it, I tried to find the cause. The temperature of the gas in the holder at 3 o'clock in the afternoon was 80°; the temperature of the gas going in from the meter to the holder was 65°, and the temperature of the air was 62°, showing, of course, that the temperature of the gas had increased by the action of the sun upon the holder from 65°, at which it went in, up to 80°; but the temperature of the gas at 65° was going down the inlet pipe through water, which was at a temperature of 44°. I had occasion to test the water some years ago for other purposes, and I had what they call a thermophone, that gave me the temperature of the water at the bottom of the holder. The temperature there was 44°, which I suppose was about what it ought to be; but we used the water afterwards and got the temperature up to 60°. On October 9th, at 12 o'clock, I read the temperature of the holder at 110°. The temperature of the gas at the meter was 65°; the air temperature was 67°. The temperature of the gas after leaving the purifier, which was about 150 feet from the meter, was 68°, or about 3° higher. Those few temperatures I have taken. On the 10th, at 10 o'clock in the morning, the temperature of the holder was 90°, the temperature of the meter was 65°, the temperature of the air 64°, and the temperature of the gas after passing through the purifiers was 66°. The last one was on November 10. The temperature of the holder then, at 10 A.M. was only 70°, the temperature of the gas was 62° both at the outlet of the purifier and the inlet of the meter; the temperature of the air was 56. That is all I have to say, gentlemen. I think it is something unusual. At the same time I have not been troubled with naphthaline, from October 2d up to the present time, and I don't think that I have had 20 complaints, while before that time I had complaints regularly around the location of my works every day, which was not very satisfactory. After using the oil I have had no complaints from any service near the works at all. Of course, I had other complaints, but they were in outlying districts, where probably the naphthaline accumulated in the pipes. I will say also that I have made some further experiments to show the effect of water upon the condensation of the gas. However, I think I am talking against time; I think I will have to stop. I did not know that I talked so much. I am surprised at myself.

The President—Don't stop.

Mr. Quinn—I did not think that I was wound up. Of course, I have always been an absorber at all of the meetings here, and have taken in all I could get. Somebody at some time suggested to me that oxide would not purify unless it was moist. Well, I moistened the oxide and I got the naphthaline. I put in a series of sprays on top of the boxes, and moistened the oxide 3 or 4 times a week, putting in a certain number of gallons; but I got all the naphthaline I wanted after that. I stopped that plan. Then somebody else suggested dry gas, and I dried the gas all right. But to show the effect of the oil upon prevention of naphthaline, the naphtha that I had used in cleaning the inlet of the holder I used in my water gas set. Well, I filled up everything at the works with naphthaline, but after I put the oil on top of the holder and in the meter I used all that naphtha up and did not see a trace of naphthaline. Gentlemen, if that information is of any use to you I am very pleased to have given it to you. Anything else that you want to ask me to answer, now that I am in a talking mood, you may ask. You don't often get me in a talking mood, gentlemen.

The President—You say that the Texas oil did not do the trick?

Mr. Quinn—Not permanently; it did for a few days.

The President—We all know where that comes from. What oil did you use that was successful? You said an ammonia oil.

Mr. Quinn—It is a lubricating oil that I had gotten over on the other side of the street, that I used for another purpose; what they call ammonia oil.

The President—Is it lubricating oil?

Mr. Quinn—Yes. I got it somewhere round this section of the country, you know; but it is a heavy oil.

The President—This is a very interesting fact, and while Mr. Quinn is in a talking mood I just want to make one observation. There are 235 members in this Association. Years ago in a certain good book there was written something concerning the use of oil on troubled waters, and of all these members there is but one man who has ever apparently known what it would do; he is Mr. Quinn. There are 234 that possibly never have read about that particular. We are going to take the whole advantage now of your experience, and really it is remarkable,

Mr. Quinn—I thought so.

The President—The gentleman referred the rest of us to using oil on water. It was effective we are told years and years ago, and it has been effective in Newport now, and I don't see why it cannot be adopted universally. Is this ammonia oil in quantity? Can it be bought everywhere?

Mr. Quinn—Oh, yes. It can be bought everywhere. Of course, I bought a low grade. It did not make any difference, though, what the price was. If it were $10 a gallon I would use it. I think it cost not more than 15 or 20 cents a gallon, so it was a pretty cheap compound anyway.

The President—I was certain that on this new point a question would bring up something of interest. Mr. Quinn, we are under deep obligations to you, and there are other gentlemen who I know will ask you some questions.

Mr. Norcross—I don't wish to be a wet blanket on the suggested practice.

The President—I don't think you will be, sir.

Mr. Norcross—And I hope that naphthaline has been got rid of permanently; but I know of an incident in the history of the Gas Light and Coke Company, of London, on these lines, which would indicate that it has not. There was a large holder at Beckton, which after a time it was noticed did not land properly. Whenever they got the lower lift on the bottom it would tilt. This became so serious that they were afraid of the holder eventually wrecking itself. The holder was landed, the water was drawn down, and then it was found that there was a heavy layer of oil on the surface of the water. Eventually, on emptying the tank, there was found a tremendous deposit of naphthaline in the bottom of the holder tank. This had deposited irregularly, some of the lumps being from 12 to 15 inches thick. That was the explanation of the trouble with the holder. They did not know why this deposit had taken place; it had never been noticed in any of the other holders, and had not been heard of in other places, so some experiments were made. These experiments in the chemical laboratory proved clearly that the oil on the top of the holder water had continuously absorbed naphthaline until saturated. This in summer time was all right, but as the oil and water cooled down with cold weather, the naphthaline in excess of saturation crystallized out and was deposited in the bottom the holder.

The President—That shows what became of the napthaline. Does anyone else wish to contribute to this discussion? We have had both ends of it. Certainly the oil made the naphthaline disappear from sight, and from the service pipes and other places. For how long a time was this oil used prior to the deposit of the naphthaline which caused the uneven working of the holder?

Mr. Norcross—The oil was not intentionally introduced, but was a deposit which had accumulated unknown during working for some years, either alternately with coal and water gas or with a mixture. The use of the water gas had introduced a deposit of oil which had formerly not existed on the water of the holders. They did not know it was there until this investigation. As they drew down the water they discovered the large deposit of oil—a heavy layer. The whole sequence of the above process was completely demonstrated in the laboratory. The deposit of the oil from the gas on the surface of the water, the absorption of naphthaline to saturation of the oil, and then the visible deposition of solid crystals of naphthaline to the bottom of the glass jars in the experiment when these were gradually cooled down.

The President—That had grown up by the natural processes of manufacture?

Mr. Norcross—Yes, sir.

Mr. Gardiner—I would like to ask if when the oil came into contact with the gas it had any deleterious effect on the candle power of the gas?

The President—Mr. Quinn, what is your experience on that? Did it affect the candle power?

Mr. Quinn—I find that instead of having a deleterious effect on the candle power, it helped to increase it 1 or 1¼ candles on 17-candle gas. I was sending the gas out all over the city and robbing it of its illuminants. My foreman on the street would tell me that when he tapped a pipe the moisture was inside and the naphthaline sticking to it. Of course you cannot rob gas of its illuminants and have the same quality of gas. On the bar photometer I found an increase of about 1 to 1¼ candles, the conditions being exactly the same, using the same grade of oil; but I will tell you that before I used this oil I was in a height of a stew. I could not get candle power enough. I used cannel coal at my coal gas plant and increased the quantity of gas oil to increase the illuminating qualities of the water gas, but the result was always the same.

The President—I think others have passed through the very same experience.

Mr. Quinn—I have had the same thing, but have done better since that time; and I don't think anything will throw a wet blanket over my holder.

The President—Of course you have never made any examination of the tank itself to see whether there was any deposit of naphthaline.

Mr. Quinn—No; but I have in the meter. This naphthaline cost my company a good many thousand dollars. First, it cost me a new governor; second, it cost me a new meter; third, it cost me lots of enlarged service pipes. My meter and governor got plugged up with naphthaline. I was talking to the governor maker for making me a poor governor, but I found it was my own fault. I was talking to the meter man, but as soon as I opened the meter I found it was full of naphthaline. The oil in the meter which is subjected to this gas passing through the meter, since the 8th day of October, has not a trace of naphthaline in it.

The President—That has all been absorbed?

Mr. Quinn—I have taken it out and tested it.

The President—That is direct testimony. This is evidently the third and last call on Mr. Quinn's talkative mood. In view of the fact that it is after 1 o'clock, and that seems to mark a division in this Association between meetings. If there are no further remarks upon this one question we will consider it closed.

A recess was then ordered until 2:30 P.M.

(To be Continued.)

[ABSTRACT.—CONTINUED FROM PAGE 494.]

FIFTH ANNUAL MEETING, WISCONSIN GAS ASSOCIATION.

HELD AT THE HOTEL PFISTER, MILWAUKEE, WIS., FEBRUARY 14–15, 1906.

SECOND DAY—MORNING SESSION.

The President—In order to vary the programme as much as possible, I think we had better for a while take up the Question Box. The first question I think was propounded yesterday and answered. The second one is:

"What kind of an open flame tip or burner gives the best results?"

which question has been assigned, I believe, to Dr. Harrop.

Dr. Harrop—That question can be answered in one of two ways. It can be answered in a sentence, saying that we always pick out the flat-flame burner that will give the best results. That might be the best answer to give to-day. The other answer would be a complete discussion of how and why to pick it out. Now I am going to try to choose a mean path between those two courses and give a short description of a flat-flame burner, pointing out how different flat flame burners vary one from the other. Flat flame disks are of two kinds, the slit and the union jet. In the old gas books they speak of batswing and fishtail burners, but these terms are obsolete. We use them occasionally nowadays, but we have no flat flames in ordinary use that are like the old batswing or fishtail burner. (Dr. Harrop here exhibited a variety of tips.) This tip which I first show you is called the Bray special. It is a standard, typical slit tip. This one is marked high pressure, 7 feet. Under ordinary conditions that will burn from 6 to 8 feet of gas per hour. I show you another of the same type. It is marked as a 3-foot burner. It represents the best type of the slit burner. I show you another slit burner, commonly sold by the department stores. It is a standard burner, on which you can place any sized tip you wish. There is no check to it. This next burner, which is called the Empire check, is a new wrinkle. The check is adjustable, and you can put on any tip you want. As I say, the check is threaded and can be adjusted to pass any amount of gas. It makes no difference what your gas pressure is on the line; if it is constant you can regulate this check to give you the pressure you want below the tip, so that you get the right kind of a flame. Now I show you another form of which I do not know the name. It is all metal and burns a good deal of gas. Here is another one which is commonly peddled from house to house. It is guaranteed that it will give more light than the ordinary burner and cut down the gas bills. We call it the "jumbo." It gives a jumbo flame—also a jumbo gas bill. Usually there is a check that goes with it, so that having set the check you can open your gas cock wide and get a good flame. Ordinarily it will burn 15 to 18 feet of gas an hour. (Laughter.) That is ordinarily checked down to burn 8 to 10 feet. It looks good for the gas company, but it is very hard on the complaint clerk. I now show you another form of tip, known as the Union jet. The best type of that is the one called the Bray special. This tip is marked "Bray Special Union Jet, No. 5," being a 5-foot burner, and I show you the same thing in an 8-foot burner. Here is another make of union jet, manufactured in this country, and called the Steward union Jet. It is very good. I now show you the commonly used aluminum tip, which is also a union jet. It looks like a slit burner, but it is made on a different principle. It has a hole drilled in the top of the jet, so that it gives two opposing streams of gas which form a flat piece jet. Here is another form, made of iron or steel, drilled with two holes, which gave opposing streams of jet, made into a flat flame. Those are sold largely for factory use. The trouble with these tips is that the iron rusts and the holes fill up, thus destroying their usefulness. These are only a few of the different kinds of open flame tips, but they cover the field pretty well. Now, in general I would say that a flat flame tip is supposed to throw a sheet of gas out into the atmosphere. If the gas pressure is too high, so that the sheet of gas thrown into the air mixes violently with the air, you will get no luminosity whatever. The gas mixes with the air and you get no deposit of free lampblack. If the pressure and velocity and thickness of the sheet of gas are co-ordinated, so that you get exactly the form of the sheet of gas you want, you get the most light out of the gas you are burning. If you have a gas of a given candle power, and the gas is under a given pressure, and you get a sheet of given thickness, and are getting a good lumsnosity from your gas, then if you have a gas of poorer candle power, and are putting it at the same pressure through the same jet, you are going to get a very poor efficiency at your burner, because a poorer gas does not want to be mixed so thoroughly with the atmospheric air as a rich gas does. On the other hand, if you use the same tip and use too rich a gas under the same pressure, giving you a sheet of the same thickness, you get a flame that smokes, so that the selection of a tip for open flame work depends on the pressure you are going to use, on the candle power of the gas you are going to burn. That is the theory of the matter. Now, in the application of that principle to the burner department of gas companies, I would say that the proper thing to do is for the department to have a meter and a collection of different tips, and then, taking the gas commonly delivered to the street, try those different tips, finding out which tip is the best looking flame, and the most light, judged by the eye under the standard pressure as it is commonly delivered to the consumer. By that means the gas company can find out which tip is best suited to its gas in its city, and in addition to that the tester may use a meter, and he will be able to tell then how these various tips that he has selected as the best for his conditions vary in consumption. That is a good thing to know about, and I think that is about all there is to say in a very short reply to a question of that kind.

The President—It seems as though Dr. Harrop had covered the question pretty well, and I will call the subject closed unless you have some specific question to ask Dr. Harrop.

Mr. Eastman—In the Empire check burner the trouble I always found is that when it is put on a 1-light chandelier or bracket, where it gets any jarring at all, the check is so loose that it will work down itself, and by-and-by you will get no flame at all.

Dr. Harrop—There is a simple mechanical solution to that objection. All you have to do is to press the slit together between your fingers; then it will be impossible for the slit ever to slip down.

Mr. Douglas—The Empire burner does not pretend to give you a tip. His question came to me as a young man 40 years ago in a very practical way, and I think the practical illustration will possibly elucidate the very point that the doctor has been making. When a young man I was in the employ of the Phoenix Gas Company, of London, and we had 10,000 or 15,000 street lamps. Forty years ago there was no electricity, and there were very few devices of any kind to regulate street lamps. One of the great pioneers in experimental and scientific apparatus had invented a governor for street lamps, and the question was how to get your street lamps to give their highest illumination, using a flat flame tip exclusively, and to save gas; because at night the pressures would rise and the quantity of gas going through some burners increased, but the luminosity did not increase, and we wanted to save gas and get the best result. The experimental work of examination of tips was referred to me, and I think I spent a continuous 2 weeks examining tips in a photometer to find out what pressure to set those governors at to get the best result, and get the best form of tip that was in the market; and, speaking from memory, I would say that we set a pressure of $\frac{4}{10}$ of an inch below the tip, and so practically got the best result. We could get a little higher candle power by going down to $\frac{4}{16}$, but the flame got lazy and there was a tendency to smoke, as the flame lost its stiffness. Now, a naked lamp with a full flame burner, ought to burn with a stiff enough flame to avoid smoking; but the lower the pressure that you can get, that means the larger the orifice in proportion, and so long as you get a reasonably stiff flame to stand draft without smoking, you will get a higher illumination. It is exactly on the same line that the doctor has stated, and I tell you that my work immediately was to change all those lamps and to put pressure governors on every one; change the whole thing right over, and I did that with great advantage. The gas we were using on those pressures was common coal gas, and in an ordinary flat tip we could not get over 13 or 14-candle power, although in an Argand lamp we could obtain 16-candle power. The size of the tip would have to be regulated in proportion to the quality of the gas. Therefore, no rule can be set saying which tip you would use and what pressure you would use. As the doctor said, it is a matter for experiment and demonstration.

Mr. Harmon—I would like to ask Dr. Harrop whether the figures given on the Bray burners themselves are stating the consumption of gas per hour anywhere nearly right—saying 7 or 8 feet per hour? Does it mean that they burn somewhere near 7 or 8 feet per hour, under the conditions given; or do they burn less?

Dr. Harrop—These figures do not mean a great deal. For an average street pressure and an average candle power the figures given on the burners are approximately correct; but if there is a big difference in the candle power or the specific gravity of the gas, the figures are inaccurate. In order to conform the amount of gas as indicated on the burner to the different conditions you would have to vary the pressure.

The President—The next question is:

> "What is the best lubricant to use on gas arc lamp keys or on keys exposed to high temperature?"

Mr. Rutledge—We are using a mixture of beeswax and tallow for that work, and have never had any trouble with it.

The President—What proportions?

Mr. Rutledge—I don't know the proportions.

Mr. Eastman—I have found pretty good success, using a fine grade of brass smoothly ground, without using any grease at all. Do not make your key too tight, but just have it so that it will not leak gas, then if the brass fittings are ground smoothly you will have no trouble.

The President—The next question is:

> "Does the compression of the gas mixture in an engine increase the work produced from a given amount of gas?"

I will call on Dr. Harrop to answer that question.

Dr. Harrop—I think it would be a long task to answer that.

The President—The next question is:

> "Granted that the ordinary open fire grate with asbestos back, burning illuminating gas through an air mixer, is wasteful and unsatisfactory, why are not heaters on the Siemens' recuperative principle, burning gas in small jets without a mixer, used in this country?"

I will call on Mr. Walker to answer that.

Mr. Walker—This question was handed to me for answer. It seems to me the only really satisfactory answer that can be made to that question is to say, as is the fact, that heaters built on the Siemens' recuperative principle, as is done in Germany, are too expensive a luxury in first cost to suit the American public. If they combine a thoroughly recuperative principle all the way through, it involves a great deal of material and a finer class of construction than we have been in the habit of putting into our gas heaters, thus necessarily raising the cost, also increasing the size of the stoves to such an extent that it really makes them cumbersome. I have no doubt, from the experiments that we tried with stoves of that character in Pittsburgh some years ago, we got much higher results in efficiency from that class of stoves than from any direct action stove we were testing at that time; but the stoves that we had were imported from Germany and were very expensive, and when we came to find out the cost of making them in this country it really made it prohibitive from a commercial standpoint. My idea was that the heating business, with gas at the prices in vogue at that time, made the heating stove a luxury, or a handy thing to have in the house, to be used only once in a while, and necessarily a very poor income producer. For that class of work amost any simple heater which costs but very little would answer the purpose of the consumer, and the gas company would get just as much out of it in the end. I think that is the only reason I can give as to why they are not used in this country.

The President—The 6th question is:

> "Are outside gas arcs for illuminating streets replacing the electric arcs to any extent in this country? Which is the latest and most satisfactory design of such gas arcs?"

I will call on Mr. Rutledge to answer that question.

Mr. Rutledge—I have been unable to find any places where the gas arcs have replaced electric or other arcs for illuminating the streets. The different manufacturers, however, are now working on that problem and expect to put something on the market for that class of work in the near future; but nothing has been done as yet.

The President—Question No. 7 is:

> "Why are direct action ranges not as efficient as indirect? Are they more difficult for the public to handle?"

I will call on Mr. Rutledge to answer that.

Mr. Rutledge—I am unable to find that the direct action range is not as efficient as the indirect. On the contrary I find, with the few tests which were made, that the direct action range is pretty nearly 20 per cent. more efficient than the indirect. In regard to the public handling these ranges, I never had any experience with the direct action ranges, excepting those that we used in our own experimental kitchen, and I am free to state that we are not able to turn out as good work from the direct action ranges as we were from the indirect, and if that would hold practically when the stoves were placed in the hands of the public, I think it is not a desirable thing to push for the use of the public.

Mr. Kimball—We went into that question last year, and while our tests were probably not as accurately made as those made by Mr. Rutledge, from a practical point of view we could see very little difference in the work, and as far as the efficiency of the work is concerned we found the direct action stove was about 20 per cent. more efficient than the other. We sold about 35 of them last year, and our customers are very well satisfied, if that is any indication as to whether they are a good thing or not. I cannot see anything against them.

The President—We will now lay the Question Box aside and return to the papers. He then introduced Dr. H. B. Harrop, of Milwaukee, Wis., who read Part III. of his contributions, entitled,

A BRIEF OUTLINE OF GAS WORKS CHEMISTRY.

Chemical Control of Works Operation.—Part I. of this series, presented at the 1904 meeting of the Wisconsin Gas Association, was devoted to the chemistry of gas manufacture, and Part II., presented last year, to by-products. The original plan, as proposed by Secretary Hyde, that the series should afford a sort of text book to be put into the hands of managers of small plants, such as most of the Wisconsin gas plants are, has so worked out that it has departed from its first intent. In this installment I hope to return in some measure to the original plan; and the present paper will be in the nature of a review, pointing out what kind of chemical work is most helpful to successful operation, describing the equipment of a suitable testing laboratory, and some additional notes.

It would be difficult to describe a laboratory that would answer at once for a small and a large works, and I shall begin by going over the tests that may be made with little skill, time and expense, and then

enumerate the more important tests that properly can and should be made regularly in larger works.

Assuming, first, a small plant where the amount of gas made does not justify extensive equipment, and where the superintendent or manager can do the testing work, we may begin with the laboratory itself. The essentials are a sink with cold running water, and a large, flat desk or table provided with a smooth 2-inch pine top. The laboratory would best be in a separate room that can be kept under lock and key.

Rather than have the laboratory in the office building, which is usually detached, I would have it in the midst of the works, preferably near the boiler house and within easy reach of the condenser house and purifying house, where a supply of steam and crude and purified gas can be readily piped (and as far as possible from the telephone). For a very large company, operating 2 or more stations, and perhaps a separate residual plant, where a considerable part of the testing work is done for the street, meter, lighting appliance, fuel appliance and gas engine departments, the locatien of the laboratory is not material, and it is found in several such companies uptown with the general offices.

For the simplest tests the following lists of apparatus and chemicals will be found very nearly to cover requirements:

A half dozen or more of each: 500 cc. boiling flasks; beakers, No. 1 to No. 5 inclusive; porcelain crucibles 25 to 50 cc. capacity; and glass funnels of different sizes. Two or 3 each: 200 cc. porcelain dishes; pinch-cocks; 10 cc. pipettes; good chemical thermometers and Bunsen burners. At least one 50 cc. burette; one 100 cc. measuring glass; 1 pair small steel forceps; 1 glass condenser; 1 or more 1 liter flasks; 1 quire No. 1 F. Swedish filter paper (or 100 S. & S. 12½ cm. folded filters); a tripod; an iron mortar; an iron support with several rings and clamps; and a supply of pipe stem triangles, squares of 30 mesh wire gauze, test tubes, glass and rubber tubing and assorted rubber stoppers, and a 2-inch piece of No. 18 platinum wire. A water bath may be made from a tin pan with a tin lid having a round hole cut in the center, and any tin dish will answer for a sand bath.

For the chemicals: 1 pound each of sulphuric, nitric and hydrochloric (muriatic) acids, lead acetate, turmeric, alcohol, carbon disulphide, and sodium hydroxide (caustic soda); ½ pound each sodium bicarbonate, dry sodium carbonate, ammonium nitrate, magnesium oxide, barium chloride, iodine and bromine; and 1 ounce each of potassium iodide, litmus and methyl orange—all chemically pure.

In addition to the above, the outfit should should include a balance. One sensible to rather less than 1 milligram can be bought for about $15. When the amount of work done is too small to justify this last expenditure, the occasional weighing might be made on the prescription balance of the nearest druggist, computing troy weight to the metric system, or vice versa, as follows:

1 grain = .0649 gramme
1 scruple = 20 " = 1.398 "
1 dram = 60 " = 4.194 "

1 mgm. = .01543 grain
10 " = .15432 "
100 " = 1.5432 "
1 gm. = 1,000 " = 15.432 "

1 oz. (av'd'p's) = 437.5 grs. = 28.35 grms.
1 lb. (av.) = 16 " = 7,000. " = 453.6 "

1 gm. = .03527 oz. (av.)
1 kg. = 1,000 " = 2.2046 lbs. "

The troy and avoirdupois grains are identical. The troy ounce, seldom used, contains 480 grains. The troy pound is almost unknown. The British imperial fluid ounce is based on the gallon of the same name and these are entirely different from the American fluid ounce and gallon.

1 fl. oz. (U. S.) = 29.57 cc.
1 cc. = .03382 fl. oz. (U. S.)

1 liter = 1,000 cc. = .0353 cubic feet.
1 cubic foot = 28.32 liters.

1 meter = 100 centimeters = 39.37 inches.
1 " = .3937 inches.

1 inch = 2.54 centimeters.
1 foot = .3048 meters.

To convert reading on Fahrenheit thermometer to Centigrade subtract 32 and divide by 1.8; to convert Centigrade to Fahrenheit multiply by 1.8 and then add 32. A set of metric weights is to be found nowadays in many drug stores, owing to the attempts of medical colleges to introduce the French or metric system in dosing.

Even when a fine balance and metric weights are available the foregoing table of relations will be of service. Gas is measured in cubic feet, coal and products in tons, pounds and gallons, the barometer and gas pressure in vertical inches of mercury or water column, etc., etc., while most modern laboratory apparatus is calibrated for measuring and weighing cubic centimeters and grammes, and the data given in most books of reference will be found in the same system. The least expenditure of time and labor is involved when we make our tests and calculations in the simple French system and then transpose the results into the English system in order to compare intelligently with the common results of good average practice with which we are familiar, as feet per pounds, pounds per ton, grains per 100 cubic feet, pounds per gallon, etc.

To determine the amount of any substance present in a complex mixture or solution it is seldom that the particular substance sought is separated out pure and weighed. Of several different methods, one is to add some reagent (chemical) that will combine with the substance wanted and form an insoluble compound, which is then separated out from the solution by means of a filter; the new compound is then weighed, and as its composition and the percentage of each of the components are known we can calculate, from its weight, the weight of the substance sought. Thus in determining sulphur (S) in a body like coal, the whole mass is oxidized, usually by combustion; in coal the sulphur may exist free, as various sulphides of iron (FeS, Fe2S3 FeS2) as calcium sulphate (CaSO4), magnesium sulphate (MgSO4), various complicated organic sulphurets, and minor compounds. On complete oxidation in the presence of a base like sodium, all the sulphur passes into the form of sodium sulphate (Na2SO4) which is perfectly soluble. The solution is then acidified with HCl, filtered to remove all the ash and unburned carbon, and to the clear solution barium chloride is added; this forms in the presence of free hydrochloric acid pure barium sulphate, which is insoluble and precipitates or settles to the bottom, the reaction being written:

$$Na_2SO_4 + BaCl_2 = 2NaCl + BaSO_4$$

From a table of atomic weights to be found in any text book we see that barium is something like 137, sulphur 32, and oxygen 16, or 4 oxygen equivalents, 64; then 137 + 132 + 64 = 233. We catch the precipitate on a filter, wash thoroughly with pure water, put into a weighed crucible, burn the paper off and weigh again. Whatever the weight of barium sulphate found, 32-233 of it is sulphur.

A large part of analytical chemistry consists in knowing what reagents to use for a given purpose, how to insure their action, what compounds they give rise to, and how to make sure that the final compound is perfectly pure and yet contains its full quota of the substance sought.

The equipment above described will cost about $20, or with the balance, $35. The smallest gas company can afford to invest that much for the sake of chemical control. With this equipment it is easy to make a great variety of determinations. The percentages of moisture, volatile matter and ash in coal and coke can be found by following the directions given in previous installments of this outline. Sulphur in coal or coke can be estimated by making a combustion in a porcelain crucible with a mixture of sodium carbonate and magnesium oxide, and then precipitating with barium chloride as just described; a full description of this, known as Eschka's method, may be found in almost any chemical text book.

A hydrometer should never be used in judging the strength of ammonia liquor. A simple titration of liquor by a standardized acid solution will tell you quickly and accurately how much free ammonia there is in any sample, and since the relation of free to fixed ammonia under like conditions is a fairly constant quantity, and the proportion of fixed ammonia is usually small, this method is sufficient for keeping in touch with everyday operation. Whenever the total ammonia is wanted a distillation test may be made at the cost of a little more trouble.

The two standard solutions used in ammonia work are made up as follows: A large crucible is filled about two-thirds full of c. p. sodium bicarbonate ($NaHCO_3$) and heated at a dull red over a bunsen burner for about one hour. The sodium carbonate (Na_2CO_3) produced is emptied into a clean, dry, glass-stoppered bottle, and the operation repeated on fresh bicarbonate until a suitable supply is ready. Weigh out exactly 52.7 grammes of this sodium carbonate and dissolve in sufficient distilled water to make one liter of solution at about 60° F.

This is called "normal sodium carbonate solution," or simply "normal alkali."

To make "normal sulphuric acid solution" proceed thus: Measure out accurately 50 cc. of the normal alkali. Mix about 30 cc. of concentrated sulphuric acid and 270 cc. distilled water, and when cool fill a burette with it and titrate the 50 cc. of alkali solution previously measured out. Suppose the 50 cc. of alkali required 14.3 cc. of the acid solution to neutralize it, then 1,000 cc., or a liter of the alkali, would require $\frac{1000}{50} = 20 + 14.3 = 286$ cc. of the acid solution to neutralize it. Then measuring out exactly 286 cc. of the acid solution, and adding enough distilled water to it to make one liter, we have a "normal solution of sulphuric acid;" and one cc. of this will be exactly equal to one cc. of the normal sodium carbonate solution.

In tightly stoppered bottles these solutions will keep practically unchanged for a long time, and can be used whenever needed, or other solutions wanted for other purposes can be based on them.

Directions for testing ammonia liquor by direct titration, or by the distillation method, with the factors for computing, are to be found in Part II. in last year's "Proceedings." For estimating the amount of ammonia in crude or scrubbed gas, the gas may be passed through a meter and bubbled through a measured amount of normal acid in a gas washing bottle. The acid is then titrated, and the difference between the number of cc. of alkali required and the number of cc. of acid first taken shows how much of the acid has combined with ammonia. Each cc. of acid combined with ammonia represents .0169 grammes of NH_3.

The gas washing bottle can be simply a bottle or flask fitted with a 2-hole rubber stopper passing 2 glass tubes, one of which reaches nearly to the bottom and into the acid. In the absence of a meter, or when it is wanted to sample against a vacuum, as from the standpipes or hydraulic main, a measuring aspirator can be made from a gallon bottle.

To estimate the free sulpher in iron oxide it is sufficient to weigh out, say 10 grammes of the oxide, previously dried, and shake in a beaker with successive portions of carbon disulphide (CS_2), decanting the liquid through a filter, and finally dumping on the oxide also and washing further with disulphide. The solution of sulphur may be evaporated and the dry sulphur weighed; or if the filter paper is previously weighed, the weight of the residue of iron and wood may be used to calculate the percentage of sulphur dissolved out. This crude procedure contains no more inherent error than any one of the extractor methods, but the copious liberation of CS_2 vapor has certain obvious disadvantages.

The same method may be used to separate free carbon from tar, and may be a quantitative determination, or merely to find if the tar is contaminated with dust, breeze, etc.

The amount of H_2S being absorbed by any scrubber or box may be estimated roughly by means of the Chollar test, which gives quick results and takes very little skill and apparatus. An equal quantity of iodine solution is put into 2 test tubes, each of which is fitted with a 2-hole cork and a glass tube reaching nearly to the bottom. One is connected with a rubber tube to the inlet and one to the outlet of the scrubber or box to be examined, and gas is allowed to bubble at a like rate through each charge. The relative times required to bleach the two solutions gives a very good indication of the relative amounts of H_2S in the gas at inlet and outlet. A little starch solution in each charge gives a sharp blue color, and the end is easier to see. The iodine solution is made by dissolving a little iodine along with 3 or 4 times its weight of potassium iodide in water, and the solution must contain some free hydrochloric acid or the ammonia in the gas will give misleading results.

The composition of gas oil and of the oils pumped from street drips may be checked readily by fractional distillation. An ordinary 500 cc. boiling flask fitted with a 2-hole stopper, 1 hole for the thermometer, the other for a piece of glass tubing 10 or 12 inches long, bent to serve as a delivery tube, answers nearly as well as a retort or distilling flask specially bought for the purpose.

Everyone knows the ordinary qualitative test for H_2S in gas—a drop of lead acetate solution on a piece of white paper held against an unlighted jet. For a continuous indication we have strips of filter paper soaked in lead acetate solution of any convenient strength and hung during the 24 hours in the gas as it leaves for the street; 2 simple contrivances for this purpose are shown this year in the Wrinkle Department. For ammonia we have turmeric paper, made by putting some powdered turmeric and alcohol in a bottle and pouring off a little of the clear, brown-yellow liquid as needed. Filter paper soaked with this liquid, dried and cut into small strips, should be kept where the gas at the outlet of the last scrubber can be tested at very frequent intervals. A loss of more than 2 or 3 grains of ammonia to the 100 feet of gas will be shown by turning a moistened strip of the yellow paper to a reddish color. (For the best results the turmeric should be washed in a filter with water and dried before treating with alcohol.) Of litmus paper little need be said; it is frequently used, but it is not so sharp or satisfactory as turmeric paper. An infusion may may be made by soaking a few lumps in hot water, and paper saturated with this infusion is sometimes used for titrating ammonia liquor in the ammonia room. Methyl orange is the best indicator for this purpose; the powder is dissolved in distilled water and the solution keeps indefinitely. A few drops in a sample of ammonia liquor produces a bright, greenish-yellow color which, on adding the least excess of normal acid, turns to a pink red, unaffected by free CO_2; its only drawback is that a strong solution of concentrated ammonia liquor bleaches it rapidly, and the rule is to dilute freely with water when working on concentrated liquor. Starch solution, for use with iodine, is usually made by rubbing up a little wheat, potato or corn starch with cold water, diluting with hot water and standing to settle and cool, using the clear solution for indicator. Starch solution prepared this way should always be made up fresh when wanted. An improved method of preparing starch indicator, due to Prof. A. S. Mitchell, is to rub up a little starch with a few drops of very strong caustic soda solution, dilute with just enough water to form a mucilage, and bottle, diluting largely a small portion of this for use as needed from time to time.

Now, we have glanced at the work that can be done with a very limited equipment, and are in a position to see that any gas manager can make sure that the coal he is receiving is really the coal he bought, by testing for moisture, volatile matter, ash and sulphur. He can keep in touch with his scrubbing system and know what duty the various machines can give and are giving; he can check up the fresh water used for ammonia absorption and prevent the crude ammonia liquor from being wastefully diluted; he can follow the operation of his ammonia still and determine the losses and trace them to their source, and keep posted on the concentrated lipuor he has for sale. The operation of his boxes, the value of the coke and tar he is making, to some extent the character of his finished gas, and a variety of other matters having a direct money interest, are within the reach of certain knowledge.

We may now pass on to consider a case where a company is willing to go further into chemical control. A good many companies employ a man with the official title of chemist who confines himself entirely to testing work, and this is usually a necessity, for much of this work requires time and continuous application. In this case it is worth while to go in for a far more elaborate equipment. Apparatus for keeping track of candle power, for making at least partial gas analysis, for determining heating power if possible, and for miscellaneous analytical work should be provided. Arrangements must be made to bring the gas from the outlet of the boxes to the laboratory in such a way that the supply pipe is constantly blown out, so that the laboratory indications follow promptly each change in the character of the gas being made.

The ordinary open flame, burned from a "union jet" or a "slit" tip, is the ultimate criterion of satisfactory candle power, of course, and anyone who has had experience can judge of the quality of ordinary gas very accurately. Where it is wanted to keep a record of candle power in terms that can be recorded, one of the common "jet photometers" such as the "Jones" is desirable. A combination of one of these jets with a pressure gauge was described in Part I. The U-gauge can be made 2 or 3 feet long and inclined at an angle of about 5° with the horizontal to give delicate readings, and if the glycerine governor is removed the instrument will be quite reliable. Such a jet, a Bunsen burner and a flat flame should be kept burning on the current gas at all times.

A home-made bar photometer to give extremely accurate results can be made at any works, the carpenter building the bar and constructing a sight-box to slide on it from a sheet of white paper spotted with candle grease and 2 mirrors. A meter, pressure regulator and an Argand burner inclosed in an Edgerton sleeve complete the outfit. (The candle balance, Hefner amyl acetate lamp, Harcourt pentane lamp, Bunsen star, Lumner-Brodhun sight-box, "flicker" sight-box, etc., are regularly manufactured for candle power taking at a round price.)

For making the temperature and barometric corrections a barometer will be needed; this can be made from a glass tube and a pound or so of mercury. If a wet meter is used, corrections are calculated from this formula:

$$n = \frac{17.64\ (h-a)}{460 + t}$$

or, with a dry meter,

$$n = \frac{17.64\ h}{460 + t}$$

where h is height of barometer in inches, a vapor tension of water at t deg., and t is temperature on Fahrenheit thermometer. The ordinary correction table used by gas companies is based on the first formula and may be employed with very slight error in the latter case.

In laying out the laboratory plenty of table room, shelves and drawers should be provided. All the soluble reagents should be made up into solutions of convenient strength and arranged in an orderly manner on the shelves. A "hood" or "fume closet," a hot plate with a smooth iron top, a water-oven heated with steam from the boilers, a drying-oven heated by gas, and a filter pump and Bunsen vacuum filtering outfit are desirable. Distilled water can be bought, but a simple still will make it as you want it, and is almost a necessity. A so-called alcohol still, of copper, answers both for this and other purposes.

The bar photometer should be set up in a separate room with light-proof shutters and blackened walls. If a room cannot be provided for gas analysis, this may be carried out in the photometer room, where the temperature is not liable to vary as in the main laboratory. In a still larger laboratory it pays to have a room for work on tar, distillation of inflammable oils, etc., lighted electrically and supplied with steam heated water oven, steam plate, and live steam for distilling.

Many of these suggestions are not strictly vital, and all cost money, but they make quick results possible and prevent annoying delays where one line of work may interfere with another.

Every gas company ought to have an Orsat, or some equivalent device for quickly estimating CO_2 and O_2 in illuminating and furnace gas. An Orsat may be used for H_2S and CO_2 in crude gas, by having 1 pipette packed with manganese peroxide and determining the H_2S with this first. The Hempel is the best apparatus for complete gas analysis, but requires skill and time to manipulate. The new Tuttle modification of the Orsat may be recommended for ordinary cases; its 2 drawbacks are the multiplicity of glass cocks which tend to leak and stick, and the incomplete absorption of illuminants by bromine; its advantages are its simplicity, rapidity and elimination of error arising from lack of skill on the part of the operator.

Since a test made on current gas at any time is not necessarily representative of all the gas made during the day, it is a good plan to have a 5-foot prover into which the gas can feed at such a rate that it will just fill in 24 hours, and make the tests desired on this sample. In place of an expensive prover, a similarly shaped receiver can be made of galvanized iron, without any regard for accuracy of workmanship, as in the case of a prover, and one could be provided for each kind of gas made.

A combustion apparatus, the Referees or the Drehschmidt, preferably the latter, is often used for estimating the "fixed sulphur" left in the gas after passing through the boxes. Care should be exercised that there are no sulphur oxides from burning gas, H_2S from ammonia liquor, or carbon disulphide free in the room. The Drehschmidt apparatus is provided with an alkali scrubber for the air; this removes SO_3, SO_2 and H_2S, but does not absorb CS_2.

As pointed out in Part I., an analysis of a gas sample affords some data for calculating the heating power; likewise an ultimate analysis of coal makes it possible to apply one of the empirical formulæ published for the purpose:

Dulong, H = 0.01	[8,000c + 35,500 (h—0)]
Bunte, H = 0.01	[8,080c + 28,800 (h—0) + 2,500s–600w]
Mahler, H = 0.01	[8,140c + 34,500h-3,000 (o + n)]

where c is parts of carbon, h is hydrogen, o is oxygen, s is sulphur, n is nitrogen and w is water, and the result is given in calories per gramme. Ultimate analysis may be made with a combustion furnace or with a Shimer crucible (preferably of the Sargent type).

But a Junkers' or similar calorimeter is more direct and accurate for gas; and since both the analysis and formulæ afford large opportunities for error, a Parr fuel calorimeter is much to be preferred for solid fuels, giving readily heating power and sulphur in coal, coke, tar, oil, etc.

Seger fusible cones, a LeChatelier thermo-electric pyrometer, or one of the other pyrometers on the market, are used for taking the temperatures in the benches and in fuel appliances.

Chimney gas and producer gas are sampled in a variety of ways according to the circumstances, and this demands some care. For nearly cold chimney gas an iron pipe in connection with a filter pump may be used. Hotter gas may be drawn from the flues through a capillary glass tube inclosed in an iron pipe. An unglazed porcelain tube should not be used, owing to the ready diffusion of atmospheric air through its walls. Mr. W. A. Baehr (Proc. Ohio Gas Light Assoc., 1903) has shown a good water-jacketed sampler for use in the producer and combustion chamber.

Volumetric analysis, which usually requires little time and trouble, is accomplished by making up solutions containing definite amounts of reagents; and then, by using some material as an end indicator, determining the volume of one of these solutions that a substance of indefinite composition requires to saturate it. The most common example of this is the titration of ammonia liquor previously mentioned, but the method is applied to many other purposes. The percentage of iron in coal ash can be determined with a standardized solution of potassium dichromate, chlorides in water analysis by silver nitrate solution, carbonates in the same event with hydrochloric acid solution, copper in bronze fittings by sodium thiosulphate solution according to the potassium iodide method, etc., etc.; these processes are all to be found in the books and are all easy and quick. There is opportunity to develop a great many new ones for gas works analysis, and in the Milwaukee laboratories a goodly number have been worked out and prove great time savers.

The following list includes the limited outfit given in the opening paragraph, and is suggested as more than sufficient, with the addition of a few minor articles, to make all the tests mentioned throughout this paper. A very complete laboratory contains a great deal more than the supplies shown, but under ordinary circumstances all the items listed will hardly be needed.

Apparatus.

Good analytical balance.
Boiling flasks.
Beakers.
Watch glasses.
Funnels.
Test tubes.
Pipettes.
Burettes.
Measuring glasses.
Measuring flasks.
Bottles and other containers.
Gas washing bottles.
Condensers.
Glass tubing.
Capillary glass tubing.
Glass branches.
Thermometers.
Hydrometers.
Specific gravity bottle.
Glass retorts.
Distilling flasks.
Thoerner gas sampling pipettes.
Porcelain crucibles.
Porcelain evaporating dishes.
Nickel crucible.
Blast lamp.
Foot bellows.
Bunsen burners.
Pinch cocks.
Crucible tongs.
Forceps.
Tripods.
Iron supports with rings and clamps.
Triangles.
Wire gauze.
Rubber tubing.
Platinum crucible, dish, wire, foil and Gooch.
Mortars; iron, porcelain, glass and agate.
Stoppers and corks.
Cork borers.
Absorption tubes.
Asbestos board.
Chaddock burner.
Still.
Filter pump.
Vacuum filtering outfit.
Extraction apparatus.
Combustion furnace or Shimer crucible.
Kjeldahl outfit.
Stopwatch.
Orsat apparatus.
Hempel apparatus.
Tuttle-Orsat.
Prover or other gas receiver.
Junkers calorimeter.
Parr calorimeter.
LeChatelier pyrometer.
Seger cones.
Referees or Drehschmidt.
Jones jets.
Bar photometer, complete.
Argand burners.
Test meter.
Pressure regulator.
Viscosimeter.
Hot plate.
Drying oven.
Steam plate.
Water oven.

Chemicals.

Acid sulphuric.
Acid nitric.
Acid hydrochloric.
Acid acetic, glacial, 99½ per cent.
Acid tartaric.
Acid sulphuric, fuming.
Acid nitric, fuming.
Hydrogen peroxide.
Potassium hydroxide.
Potassium dichromate.
Potassium carbonate.
Potassium permanganate.
Potassium iodide.
Potassium chlorate.
Sodium metallic.
Sodium hydroxide.
Sodium carbonate.
Sodium bicarbonate.
Sodium thiosulphate.
Copper foil.
Copper turnings.
Cupric chloride.
Black oxide of copper.
Copper sulphate.
Silver nitrate.
Lead chromate.
Lead acetate.
Cadmium chloride.
Mercury.
Mercuric chloride.
Platinum chloride.
Stannous chloride.
Bromine.
Iodine.
Sulphur.
Phosphorus.
Powdered silica.
Asbestos.

CHEMICALS—*Continued.*

Sodium peroxide.	Starch.
Sodium phosphate.	Turmeric.
Soda lime.	Litmus.
Ammonia.	Cochineal.
Ammonium carbonate.	Methyl orange.
Ammonium chloride.	Phenolphthalein.
Ammonium oxalate.	Potassium chromate.
Ammonium nitrate.	Potassium ferrocyanide.
Calcium carbonate.	Pyrogallic acid.
Calcium chloride.	Carbolic acid.
Magnesium oxide.	Picric acid.
Barium chloride.	Analine oil.
Barium hydroxide.	Naphthaline.
Manganese dioxide.	Benzene.
Pure iron wire.	Pentane.
Ferric chloride.	Amyl acetate.
Ferrous sulphate.	Alcohol.
Ferrous sulphide.	Ether.
Nickel nitrate.	Carbon disulphide.

After discussing the very simple testing outfit first given, we considered some work that could be done with it. We may now glance over the additional classes of work that may be done with the fairly complete equipment that has since been described.

We can control our producer furnaces and boiler furnaces by means of gas analysis and pyrometry, to get the least loss by excess air, escaping combustible gases, and excess ash pan water, aiming to get high fuel economy. We can keep accurate check on the temperatures of our retorts and settings, regulating the heats, size of charge, and length of carbonizing period to minimize standpipe stoppages and naphthaline troubles, and get the greatest yield of the best gas, tar and ammonia. The proper vacuum and seal to be kept on the hydraulic main can be determined by experimenting with an eye to candle power, CO_2, O_2, yield and effect on condensation. The air used in purification may be increased to the maximum of safety; the proper differential for the tar extractor and the best temperatures for the tar extractors and the condensers may be determined intelligently. We are in a position to make analyses of firebrick and tile, iron and bronze fittings and sundry other purchases, tests of lime for the ammonia concentrator and the purifying house, of alcohol for frost stoppages, examinations of lubricating oils, and corrosions may be explained and avoided; and every opportunity is at hand for studying incandescent burners, mantles and other fuel appliances, and carrying out investigations leading to new uses for residuals and added economies or profits. There is practically no limit to the control tests that may be made to secure the best results.

Some companies believe that it pays to employ a chemist. A good deal depends on the man. If he has had an engineering education as well as a training in chemistry, so much the better for his laboratory and his work. A good deal depends on the company's policy. More than one company that is wondering how it is possible to figure out any earnings from the laboratory is requiring the chemist to devote 95 per cent. of his time to routine candle power tests and ammonia liquor tests, because there are blanks for these reports in the carbonizing book.

During the reading of his paper Dr. Harrop made the following comments: On page 7, 18 lines from the end, after the words "inlet and outlet," he said: That is not the test first published by Mr. Chollar a good many years ago." It is not commonly known, but is very easy to make, and is very valuable. Page 8, 17 lines from the top, after the words "It is frequently used but is not so sharp or satisfactory as turmeric paper;" I recommend turmeric paper always instead of litmus, which is affected by CO_2, and does not give the delicate indication that turmeric paper does. Page 9, end of the paragraph, after the words "Character of the gas being made." I have heard of cases where the manager of a plant, who had a retort or work foreman would rush to the retort house and raise Cain because of the poor gas he said was being made when the trouble really was in the office. In the case I have in mind a 2-inch pipe was running from meter to the manager's office, and it was so dirty that it took an hour to blow it out. That is not a joke, it is a fact—the manager was a bright man, too. Next to last line, page 9: "That combination I showed 2 years ago, and it seems to me that every small gas works, and for that matter large gas works too, should have one or more of those apparatus going. It gives a rough indication of the character of your gas. I will say, however, that the glycerine governor does not regulate very well. The tendency is to blow it out under high pressures, and dirt injures it; therefore, we have removed that governor entirely, substituting a pressure gauge, and a finely adjustable pressure regulating cock. We also use a rather expensive balance cover which obviates the necessity of adjusting the cock. The gauge is the best part of the plan, because it tells you whether or not your pressure conditions are the same. Page 11, at end of next to last paragraph, after the words "For each kind of gas made," I regard that as a very valuable suggestion. Every company should have that. We sample all our gas here in separate provers, and are in position to know how the different kinds of gas we have made in the last 24 hours, test, what kind of gas it is, and how the mixed gas runs.

Discussion.

Mr. Wheeler—I think the Wisconsin Gas Association during this last year, through Dr. Harrop, including this paper, has worked out a very complete gas works chemistry, and if the 3 years' proceedings are published in a single volume, available for sale, the gas fraternity will have a very good text book. At the present time we have to go to England for our gas works' chemistry, and I think now we will have a treatise that, if published in book form, will prove convenient for everybody. If the three papers of Dr. Harrop were put into one little book, with some additions that might suggest themselves to him, the book would have a large sale, and I think Dr. Harrop (or the Association, if the Association sells the book) could really get quite an income from it. It is valuable for all young men, and for the older members also.

The President—I think that is a very good suggestion. I would like to ask Dr. Harrop if he has anything of that kind in contemplation.

Dr. Harrop—Speaking in reply to that, I had some such idea when I began this series, and I have borne in mind more or less, in getting the material together, that when the work was concluded I might revise it and publish it. I would like to see that done, especially as nothing of the kind has been done in America, and it is necessary now to go to England for our information on the subject of gas works chemistry. The only suggestion that does not appeal to me is the idea of selling the book. The first two papers have already been published in the AMERICAN GAS LIGHT JOURNAL and reprinted in other magazines. They have been copied in England in part; and I have an idea that the fate of this particular part that I have read to-day will be about the same. It does not seem to me, when a thing has become common property in such a sense, that we ought to charge for it. On the other hand, it is going to cost the Association something to publish it. I simply throw that out as a suggestion and as my opinion on the subject.

Mr. Corscot—I desire to move, in relation to this matter, that 500 copies of these papers of Dr. Harrop's, with such corrections and additions as may occur to him and as he is willing to make to them, be printed at the expense of the Association, that one copy be furnished gratis to every member of the Association, and that the remainder be kept in the hands of the Secretary-Treasurer, to be sold at the cost price per copy to those who want it.

Mr. Douglas—I thoroughly appreciate the value of Dr. Harrop's work. Some of our older men, as I call them—19th century men, to go back a little to the idea that you find among gas men—say that we want practical men, and that we do not like the scientific men. Some little evidence of that idea appears cropping up even in our meetings here, and I want to say, especially to the younger men, that you have to be 20th century men, which means that you have to be not only practical but scientific. The 20th century man has to be. It is absolutely essential to the young man in the gas business in a small town, if he wants to succeed for himself, leaving out of consideration his own company, that he must become a student. If he is to occupy a higher position in the gas world he must study chemistry. The mere reading of books, however, will be of little value to him, unless he is continuously working practically in the laboratory. He cannot understand the reactions taking place from mere reading. He must go through some actual manipulation of his own in a practical way. I say it advisedly to the young men: You must become students if you want to go ahead in the gas business, and especially must you study chemistry. Dr. Harrop, of course, is a chemist of the highest type, not only in the line of gas works chemistry, but in every other direction, and he is quite prepared to take up the chemical end of any problem and discuss it, and he has prepared a practical handbook which is of the greatest value to-day to every young man working in his own small gas plant. As a rule directors are averse to spending money on what they consider things that do not earn anything, but if they find that the young man is determined to go ahead and learn chemistry, and that he feels that it will redound to the benefit of the company, they will, as a rule, appropriate all the money necessary for the equipment of the laboratory. I certainly do recommend it most strongly, and say it to the young men who are representing me and who will take my place in Eau Claire, that if they show that willingness to use a laboratory and enthusiasm in doing

this work that I believe is so commendable, the company will go to all the trouble and expense of providing them with the necessary laboratory equipment; and, viewing the matter purely from the commercial side, I know we will get value received for the investment. Therefore, I want to second Mr. Corscot's resolution, leaving the form of this for revision, and putting it into such shape as Dr. Harrop would like, so that the work may be used as a practical handbook for gas men; and I do think, notwithstanding what the Doctor has stated in his modest way, that he can give us a better handbook of practical chemistry for gas work than any other book yet published, or at least that has come to my notice; and instead of thinking that it will not be sought for, I believe it will be very popular, not only in the United States but abroad. Regarding the cost of publishing the work, I do not know the financial condition of this Association, but Mr. Corscot, being the President-elect, will, of course, look after that matter.

The President-elect—It occurs to me that perhaps Dr. Harrop might desire to have the work copyrighted.

Dr. Harrop—I have no such desire, and as two-thirds of this work has been published many times already, it would be impossible to take out a copyright on it, as I believe.

The President—The publishing of the parts that have gone before is in the same line as the publishing of many good stories in advance in serial form in magazines. It is finally published in book form, and the books meet with ready sale. The only objection that I would make to the Corscot motion is he specifies these books should be sold at cost. It seems to me that it might be left to the discretion of someone to charge a small margin of profit on the book.

Mr. Corscot—I will accept the amendment, with the consent of the second, and leave it with the Secretary-Treasurer to sell them at such price as may net a small profit, after supplying the members of the Association, as stated, without expense.

The President—Have you any idea as to how much it would cost to publish this work in book form?

Dr. Harrop—I think it would cost somewhere in the neighborhood of $100 for 500 copies.

[Motion unanimously carried and so ordered.]

The President—Is there any further discussion of Dr. Harrop's paper?

The President-elect—I simply desire to say that we are getting now to a point where the lawmaker is taking an interest in us, and it behooves us to know what kind of gas we are making—how many heat units and all that sort of thing; and it strikes me that Dr. Harrop's paper is going to be right in line, and be of very material benefit to every gas company in the State of Wisconsin. The old fogies, like myself, of course, who are not up on chemistry want someone to help them out, and this handbook would be of great value to them, and incidentally to the companies by which it will be used. More than that, as Mr. Hyde just suggested to me, the idea of the Association publishing something of this kind I think is worth considerable.

Mr. Patten—I would ask Dr. Harrop whether we small fellows, without a technical knowledge of chemistry, would be able to work out these tests with this limited equipment, to any degree of proficiency; that is, if we closely followed the instructions.

Dr. Harrop—That is a pretty hard question to answer; it depends a good deal upon the man. The paper just read details all the tests mentioned in the last 2 years, and most of them are very simple. No directions are given in the paper for making those tests, but all can be found in almost any one of the common text books of analytical chemistry. The directions given are usually very full, and chemical analysis is really nothing but a mechanical operation. It requires a man to be a little delicate in the sense of touch, and to be careful and clean in his work, but any man careful with his figures, as an engineer ought to be, should be careful in handling his materials, see to it that he spoils nothing, that he gets no cigar ashes in the material to be tested, and does not leave it around for the janitor to sweep dust in it, etc. It seems to me that anybody with a fair amount of intelligence, an ordinary engineering training, and a knowledge of such things as most of them have, can make most of those simple tests suggested, by following out the instructions given in an ordinary book on analytical chemistry. When you get into the largest class of tests given in the latter part of the paper, it is a different matter. To handle those tests a man must have a pretty good knowledge of what he is trying to do, and while a great many of those tests could be made by men without knowledge of chemistry, there are others that could not be so made, which should be intrusted only to someone who has had a schooling in chemistry.

The Secretary—Can Dr. Harrop tell us of any make of calorimeter for testing British thermal units in gas except the Junker apparatus, which is very high priced, costing $200 or $225, a price which is pretty high for the average company to pay for such instruments?

Dr. Harrop—There is an English calorimeter, made by the Simmance-Abady people in London, which is practically nothing but a Junker calorimeter with a wooden jacket, and instead of having a difference of level for giving a constant rate of water fall, has a pressure indicator which is inferior to the weird arrangement of the Junker device, and which also tends to sweat on warm, moist days, and allows some condensed water from the air to run down and join with the water of condensation in the gas, and which has a number of disadvantages like that; but it gives fairly good results, and it is very much cheaper than the Junker device. I do not know what it is sold for in England, or what it would cost in this country with the import duty added. I have the figures somewhere, and it seems to me the apparatus can be bought for something like $100. I do not remember whether that includes the test meter or not. The Schaeffer-Buddenberg people say they are perfecting a calorimeter which they will soon have on the market. I do not know whether they have actually produced it or not as yet. Finally, the Improved Equipment Company, of Denver, expects to put on the market a calorimeter on a slightly different principle, where they displace a cubic foot of gas with a cubic foot of water, and the same reservoir measures the gas and the water, and the only factor required is the weight of a cubic foot of water in pounds. We have been expecting that calorimeter for a couple of years, but we have not seen it yet.

The President—I think the fact that this Association has voted so unanimously and so enthusiastically, Dr. Harrop, to have your papers prepared in book form, is evidence that these papers are appreciated, and I thank you on behalf of the Association for your work.

(To be Continued.)

Blast Lamp for Gasoline or Artificial Gas.

Mr. Randolph Bolling, of the Nova Scotia Steel and Coal Company, in an article communicated to the last issue of the *Journal of the American Chemical Society* respecting the matters named in the heading, said:

The writer has designed the burner shown in this drawing, and while

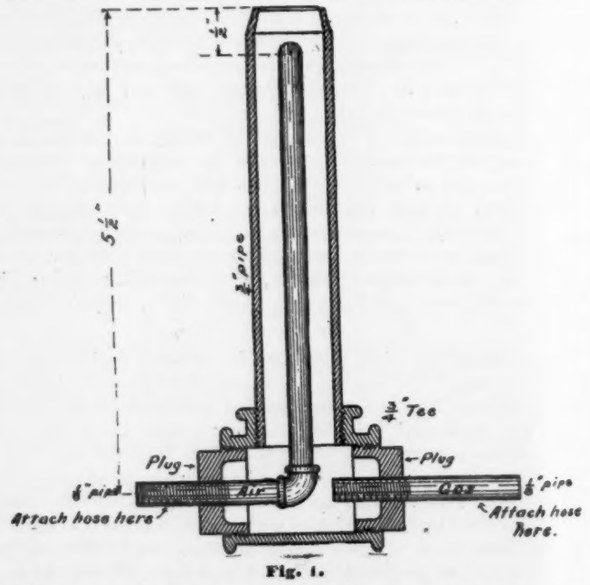

Fig. 1.

no claim whatsoever is made to any originality, he thinks he may confer a favor in describing it to iron and steel chemists who have had some trouble in obtaining a good blast lamp and who require a high temperature burner at a greatly reduced cost. All the materials required are ¾-inch tee, ¼-inch pipe, ⅛-inch pipe and plugs of brass. They are assembled as shown. The wooden block shown in Fig. 2 is the support for the burner. It can be secured to the laboratory desk by a rod and tap, a hole being bored through the center of the block. This gives perfect rigidity with enough play to get the burner directed at any convenient angle. The air pipe is usually reduced to various sizes of capillary bore, from $\frac{1}{64}$ inch up. This, of course, must be determined by the pressure of air available and the kind of work the burner is required to perform. In this laboratory I have 6 in use, giving anywhere from a brush flame 20 inches high to a fine "hat pin" flame. The air

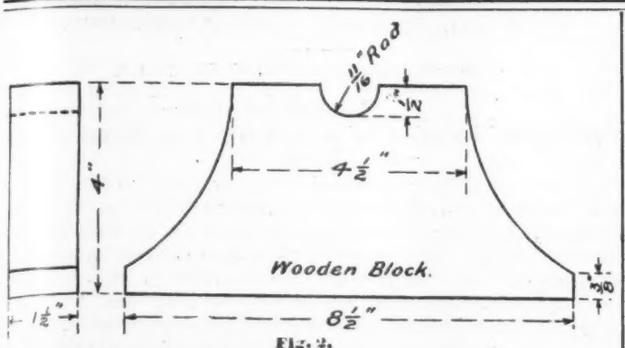

Fig. 2.

supply is compressed air at 80 pounds pressure from a main supplying the steel works. Any pressure will work very well. The gas is made by forcing air through gasoline contained in a 60 gallon steel tank, with proper safety and check valves. The blast lamp materials and time will cost 30 cents each, so that it represents quite a saving over the usual burner sold, and it operates perfectly and gives an intensely hot flame. Silica may be blasted to whiteness in 1 minute easily and ore fusions made with great rapidity. It is admirably adapted for carbon combustions in a platinum crucible, giving the bottom of the Shimer crucible an intense heat, so hot indeed that the film of carbonaceous matter can be burnt from the top of the Gooch crucible inclosed.

The Effect of Acid Frosting and Inclosing Globes Upon the Life of Incandescent Electric Lamps.

By Messrs. J. R. Cravath and V. R. Lansingh, in *Elec. World.*

The last few years there has rightly been a tendency in incandescent lighting to lower the intensity of the source of light, either by using inclosed diffusing globes or else by frosting the lamp bulb itself. The diffusion obtained by these methods has not only resulted in more artistic effects, but has also made the light much easier on the eyes, and has undoubtedly aided in popularizing the use of the incandescent lamp. In this connection, the question has arisen as to the relative efficiency of the two available methods, which are:

1. Frosting the lamps themselves and using them without inclosing globes.

2. The use of the bare lamp with a diffusing inclosing globe either ground glass, opal, holophane or other types.

It has generally been conceded that a frosted lamp, as far as efficiency is concerned, is more economical than a plain lamp with a diffusing globe. Generally speaking, the absorption by such frosting is in the neighborhood of 10 per cent., while with the use of ground glass, and other types of diffusing globes, the absorption runs from 12 per cent. to 25 per cent. or more. The question as to the effect on the life of the lamp has, as far as the authors know, never been satisfactorily answered to date.

The authors, in previous articles in this paper, have advocated the use of some sort of cover or gasket for the neck of an inclosing globe, such a cover being formed of asbestos, mica or some similar material which will keep out all dust and, in the case of white asbestos, increase the light below the horizontal. In order to determine the effect on the life of the lamp, with these various conditions, tests were made on the following at the Electrical Testing Laboratories:

1. Frosted lamp, bare.
2. Clear lamp and diffusing globe.
3. Clear lamp, diffusing globe and asbestos cover.

Thirty lamps were selected from among a large number which were purchased direct from the manufacturer. They were of 16-candle power, 115-volt, 3.1 watts per candle, oval anchored filament type. These lamps were selected with a view to securing those free from perceptible defects. When received they were divided into three groups. In making this division the only consideration was the efficiency; an endeavor being made to have the same average candle power and watts consumed for each of the different groups. One of the three groups was then taken to the factory of the manufacturer and was there frosted by the usual acid process. The 10 lamps after frosting were again photometered in order to determine the absorption and modification of the distribution of light, due to the frosting.

The inclosing globes used were of the "holophane" type, being spheres, 6½ inches in diameter with 3½-inch holders. Ten of these were used without any cover while 10 others were protected with an asbestos disk or washer which practically prevented any dust from entering and, at the same time, had a tendency to throw down any light striking the white surface. This type of globe was selected for the reason that while the glass is heavier than the ordinary type of globe, the increased radiating surface, owing to its numerous prisms, would tend to increase the radiation.

The first tests made were to determine the absorption and modification of the distribution of light, due to the three methods given above. As will be seen from the data given later, the loss of light due to the frosting of the lamp itself was 9 per cent., while the loss due to the absorption of the globe was about 16½ per cent. The distribution of light, as thus obtained with the above combination, is shown in Fig. 1, where

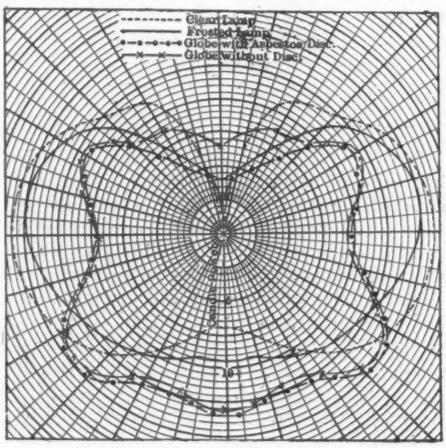

Fig. 1.—Curves of Light Distribution.

the photometric curve of the bare lamp is also given for the sake of comparison.

The effect of frosting a lamp is to decrease the candle power at all angles, with the exception of that directly underneath and directly above the lamp.

The type of globe used in this test is known as one which aims to diffuse the light in all directions below the horizontal rather than redirect it in any one direction. This is shown by Fig. 1. It will be noticed that the use of an asbestos disk slightly increases the useful light at all angles below the horizontal. Other things being equal, it would seem desirable to use asbestos disks with any form of inclosing globe, thereby preventing the accumulation of dust on the inside and increasing the useful illumination at the same time. In this connection it should be noticed that the use of such a disk or washer prevents the dust from settling on the lamp itself as well as on the inside of the globe. The importance of keeping the inside of the globe and the lamp itself perfectly clean has been well brought out in tests reported on by Messrs. Legg and Townsend at the Chicago Public Library, where in the case of clear lamps and porcelain reflectors, the average increase of light, due simply to wiping off the lamps and shades with a cloth, was nearly 30 per cent.

After the absorption tests were finished the three groups of lamps were placed on life test. All were burned pendant upon the same racks and under the same conditions; a frosted lamp, a lamp in a holophane globe, and a lamp in a diffusing with asbestos disk being placed in turn. All were operated on a 60-cycle, constant potential, alternating current system, in which the average pressure fluctuations did not exceed ½ of 1 per cent above or below normal.

The lamps were burned under such conditions throughout their useful lives. Neither the frosted lamps nor the globes were cleaned in any way.

After the test had been in progress 144 hours and 336 hours respectively, the mean spherical candle power of the 10 frosted lamps was determined. After the test of the lamps burned within the globes had been in progress 288 and 516 hours respectively, their mean spherical candle power values when used with the globes was determined. At more frequent intervals, the mean horizontal candle power of the lamps was determined in order to establish the rate of deterioration in candle power.

	Group No. 1 Frosted.	Group No. 2 in Globes.	Group No. 3 in Globes and Disks.
Initial m. s. c. p. as modified.....	12.2	11.1	11.1
Watts per initial m. s. c. p.....	4.15	4.55	4.55
Per cent. loss of light as compared to clear lamps.....	9.0	16.5	16.5

Mean zonular candle power.

Lower 45° zone.....	10.6	12.9	13.4
" 60° "	11.3	13.4	13.9
" 75° "	11.8	13.2	13.5
" hemisphere	12.4	12.4	12.6

Because of the nature of the light units tested the only practicable method of comparison is on the basis of mean spherical candle power. All candle power results shown in this report, are therefore reduced to this basis. The lamps were burned in every case to 80 per cent. of their initial mean spherical candle power.

The net results of the tests made at the beginning are given in the following table:

Life Tests of Lamps.

	Group No. 1 Frosted.	Group No. 2 in Globes.	Group No. 3 in Globes and Disks.
Average life to 80 per cent. of initial c. p.....	216 hours	428 hours	423 hours
Corresponding candle hours.	2,383 "	4,401 "	4,384 "

In studying the results we note that the loss of light, due to the frosting of the lamp is 9 per cent., while in the case of the type of globe used in this test the loss was 16½ per cent. When, however, the question of life is considered, we find that the life with a frosted lamp is only 216 hours, whereas the globes under test give 428 hours or nearly twice the life. If we multiply the average mean spherical candle power by the number of hours of useful life, we find, in the first case, we have 2,383 candle hours, while in the second place we have 4,401 candle hours; an increase of 85 per cent. Fig. 2 shows the life hours

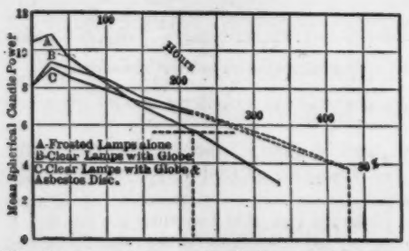

Fig. 2.—Curves of Average Candle Power Performance

and the candle power graphically. Care should be taken not to confuse this with horizontal candle hours commonly used in considering the life of incandescent lamps.

Coming now to the question of absestos disks in the neck of inclosing globes, we find that the total flux of light is practically the same in either case, but that the light in the lower hemisphere is increased about 2 per cent., and that the loss of life, due to the same, is only about 1 per cent. Inasmuch as there is a great gain due to the fact that dust is prevented from falling on the inside of the globe, and also on the lamp itself, it is beyond question a desirable thing to equip all pendant inclosing globes with some form of cover to prevent the collection of dust or dirt. Dirt collecting in the bottom of a diffusing globe is not only a cause of loss of light, but is inartistic and slovenly. It shows much more plainly in a diffusing globe than in any other and should be avoided both on account of the efficiency and appearance.

The object of frosting lamps is to cut down the intense glare of the bare filament with the least possible loss of light, rendering the lamp more agreeable to the eye and giving a more artistic effect. In many instances, the same results can be obtained by the use of ground glass diffusing globes with a corresponding increase in the life of the lamp. Where a reflector is needed and at the same time diffusion of the light from the lamp filament is advisable, a frosted bulb lamp is still the most easily available device for securing diffusion. It is to be regretted that the tests did not include ground glass as well as diffusing globes, but judging from the tests given in previous articles in these columns by the authors on the absorption by ground glass globes, it is probable that a test on these would show very nearly the same results as here obtained.

The usual guaranteed life of bare lamps of this kind with clear glass bulbs is 450 hours. The loss of life by inclosing them in globes is, therefore, about 5.5 per cent. while the loss of life by frosting is about 52 per cent.

THE Pintsch Gas Compressing Company will construct a plant at Columbia, S. C.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, March 10th, 1906.

Stand-bys and Irregulars.—A Sensible Rule Successfully Contested. —The Lights of London.

All who are actively concerned in the everyday work connected with the manufacture and supply of gas, cannot fail to be occasionally reminded, and that with increasing frequency, that the Parliamentary regulations under which these operations are conducted have become so antiquated as to stand in need of entire revision, if they are to be of any use at all in connection with present day conditions. They have always been more remarkable for law than for common sense, and for containing too much of the lawyer and too little of the practical man, and they are based more upon artificial assumptions than on practical facts. Two of these assumptions are that gas commands a monopoly as an agent for artificial light, and that its use in that connection is the only one that need be considered in practice. It is very doubtful if these ideas were anywhere near the mark at any time, but the trend of events is to get further and further away from them. Probably there was never more gas used for lighting than at present, but the increase in lighting has been surpassed by the demand for cooking, warming, motive power and technical purposes. The consumption for all purposes has more than doubled in 20 years, and the last named have played a more important part in regard to this very satisfactory result than the first. It was not only assumed that every consumer would use gas for lighting, but further, that he would use it without intermission. The lighting requirement can be taken as fairly regular according to the season of the year, but the engineer who calculates on lighting considerations alone is likely to come to grief. Yet all the statutory regulations affecting the privileges of users, and the obligations of suppliers, are based on the assumption that there is no such thing in practice as a stand-by or an irregular customer. The matter might be assisted by a common sense definition of a "consumer," although some of the acts go even wider than that, and specify that any owner or occupier can demand a supply of gas.

Take one or two examples. A large factory owner has some spare power, and finds it advantageous to light his premises by means of electricity. But at the same time gas is very convenient as a second string, especially if the onus and cost of maintaining it as such can be shunted on to the gas company, and so he goes to the gas office in the guise of a regular consumer, and demands a meter and service of a capacity equal to the maximum rate of consumption. Usually they can charge a nominal rent for the meter, but some, like the Gas Light and Coke Company, of London, have to supply meters free. In another case, a consumer has a large burner for technical purposes, perhaps to burn off the carcasses of dead pigs, or to braze bicycle wheels. It uses a lot of gas while alight, but unfortunately the time of use can be reckoned in minutes per month. Nevertheless the gas suppliers are called upon to provide a large meter and service. A third example is that of offices only used in the daytime and fitted with gas fires, that in a mild season may not be wanted 6 days in the year.

In cases of this sort the company incur a substantial capital outlay, say £10 to £20, together with annual working expenses. Even if the customer pays for the service and meter the case is not entirely covered. The service pipe contributes its quota towards the loss by leakage to a greater extent if not used, and the rental clerks and meter inspectors must be paid in any case. Every name on the books, every meter *in situ*, and every live service mean not only direct but also indirect costs. For behind all this is the question of whether the dry meter as usually supplied is a fit and suitable appliance to take care of an intermittent or irregular consumption. In practice the larger the proportion of nominal or of small consumers the larger the loss by "leakage." Any person can throw this important expense and responsibility on the gas company without incurring the slightest liability in return, which is a very one-sided bargain.

Like all other questions relating to the working expenses of a gas undertaking, this is a matter that affects the consumers first, and the gas company second. Suppose a score or a hundred stand-bys come into the district. The gas company had their limited dividends before and continue to have the same. *Who pays the extra expense?* It does not mean less profit for the shareholder but it does mean a higher price for the consumer. The position has been recognized in connection with rating assessments and any one ratepayer can object to the assessment of any other, because a low valuation means a deficit to be covered by the general body. But whoever heard of a gas consumer troubling

himself about the gas company being put to extra expense. He laughs, and his sympathies go against them. And the shareholder, in the quietude of his own sanctum, looks at the cheque for his full dividend, and does a little laugh on his own account.

In no case has this trouble become acute enough to show any important effect on the finances. But it is easy to see that a company with 10 per cent. or so of stand-bys on the books must charge the cost of the same over the general body of consumers. All this being properly considered, it is possible to dress the stand-by in his proper colors, and to recognize and deal with him on his own merits, and not under the disguise of a "consumer." If he requires the privileges of a regular customer without the corresponding obligation to use the gas, he must be prepared at least to pay his footing by means of a minimum charge based upon the size and length of service. And gas companies should have some option in respect to customers who turn on their supply at times during the maximum consumption, or in other ways cause inconvenience. It must be recognized that there are all sorts and conditions of consumers, each of whom requires special treatment.

The Bristol Gas Company has successfully defended an important point before the magistrates. Some few years ago they decided that all service supply pipes should be of lead and laid in a wooden trough, as it was found that wrought iron pipe corroded when buried in the ground and that pipes of that material could not be depended upon to keep sound for 20 years. All new services are laid subject to that condition, and with regard to iron ones already in use it has been the practice to demand that they should be replaced with lead whenever there was a change of tenancy. A consumer moved into a house furnished with a wrought iron service laid 20 years ago, and demanded to be supplied with gas, at the same time refusing to renew the service. The company refused to supply him until their regulation had been complied with, and he then proceeded against them for the penalties due for failure to supply. His case was that the existing pipe was in good order and that he should not be put to the expense of a new one. The gas company showed that the regulation in question was authorized by their special act of 1899 and that the pipe was so far corroded that they were warranted in refusing to accept it. The magistrates held that the case must be dismissed, as it had not been shown that the company superintended the laying of the old service, or accepted it otherwise than by supplying gas through it for a time, while the evidence satisfied them that a wrought iron pipe became unsafe in 15 to 20 years, and the complainant failed to furnish evidence in support of his statement that the pipe was in good repair.

Considering that the pipe is used for conveying gas that is the property of the company, they can certainly claim with reason to have something to say about it, nor can it be supposed that they would hinder the use of gas by fanciful or unnecessary regulations. As above remarked, it is the consumer that benefits first by any scheme that reduces expenses, while the suppliers only gain indirectly. Probably the result of this very necessary and sensible rule at Bristol, where a large portion of the area comes under tidal influence and salt water, is that gas can be sold substantially cheaper, perhaps 4d., perhaps 2d. per 1,000, so that the customer soon recovers the cost of the service pipe.

London is now in a fair way to redeem its reputation in the matter of street lighting. It has been very slow to move considering that many comparatively small provincial towns have been well lighted by Kern burners for years past, single No. 3 or No. 4 in the principal streets, with clusters of 2 or 3 burners at the principal crossings, squares and wide thoroughfares. Londoners appeared to be under the impression until very recently that the only practicable improvement on the 5-foot batswing gas burner was the electric arc. Like the old lady who found spiritual consolation in that blessed word Mesapotamia, they were dazzled by the candle power claimed, and led into the delusion that the 2,000-candle arc would render the streets as bright as day; 2,000-candle looks big on paper but fails to fill the bill in the streets. With the very highly rated arc lamp came the idea of mast lighting, which was supposed to be conducive to better distribution of the light. It is now generally recognized that however effective the arc may be when applied regardless of expense for the illumination of open spaces, such as public gardens, it is neither efficient nor economical for ordinary streets or crossings. As a consequence, it is rapidly being displaced, and the visitor to the metropolis who strolls round the principal thoroughfares at night will find more incandescent gas light than arc light, and be able to compare the steady, colorless rays of the former with the fitful blue-and-pink flicker of the latter. There are certainly some oddities in the way of fancy electric lighting to be seen—glaring yellow lights and the sickly blue vapor lamp—but the public do not want colored lights except for special advertising or spectacular purposes. Standing at a corner and looking down one vista lighted with arc lamps, and then turning to another furnished with incandescent gas, the observer cannot fail to notice the defects of the mast system. The best of the lighting is along the third floor line of the buildings, while the surface of the road is in shadow and even the curb line is invisible for long stretches between the lights. One cannot tell the material of the road or the footwalk paving, nor would it be possible to recognize an acquaintance at a distance. A black shadow crossing the road may be a male or female. Turn from this to the gas lights properly spaced and about 15 feet high. The bulk of the light is in this instance where it is wanted. Perhaps the third floor decorations are not quite so clear, but the curb line each side is perfectly distinct, the passengers are plainly discernible, and one can recognize a familiar figure or tell whether the man who has just turned a distant corner is a soldier, a policeman or a civilian. But not only in efficiency but also in the important item of cost does the once disparaged gas take the lead. The comparison would be still more in its favor if the respective costs were ticketed on the standards.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. Fred H. Freese, of Fort Wayne, Ind., writing to us from there under date of the 17th inst., says: "I am pleased to advise you that Messrs. W. A. Martin and Emmett Scott, of La Porte, Ind., J. M. Ott, of Albion, Mich., and F. W. Freese, of Fort Wayne, Ind., are the incorporators of a new Company and will build a coal gas plant at Rohester, Ind. Mr. F. W. Freese has been awarded the contract for the erection of the plant, which is to be an 8-inch works, with a holder up to retaining 25,000 cubic feet. The Kerr Murray Manufacturing Company, of Fort Wayne, will furnish the apparatus."

The proprietors of the Allentown (Pa.) Gas Company have arranged to extend the main system to East Allentown, and there is more than probability that the lines will also be sent on to Rittersville.

The Wayne General Construction Company, of Fort Wayne, Ind., has been granted a franchise for the construction and operation of a gas plant at Garrett, Ind. The maximum selling rate is put at $1.50 per 1,000, with 15 cents per 1,000 off for prompt payment. The population of Garrett is just under 6,000.

"R. F. D.," writing to us under date of the 19th inst., incloses the following: "The installation of a modern gas plant in Owatonna, Minn., will be commenced some time next month, so says General Manager C. D. Powell of the Owatonna Gas, Heating and Electric Company, who was in the city this week making final plans for this important undertaking. The work involves the construction of about 6 miles of mains, a holder of about 60,000 feet capacity, and a new building to cost about $3,000 on the grounds of the electric plant. An investment of about $40,000 will be represented in the completed plant, and a crew of from 40 to 50 men will be kept busy in the city a large part of the summer. The work includes the tearing out of all the present mains and the replacing of them with larger and better piping. An 8-inch main will be laid to the center of distribution, which will be about the center of the city, and from this will radiate 6, 4 and 3-inch mains according to the territory to be supplied with gas. The plant will be of the carburetted water gas type. It will be a first-class article, the Company believing that the use of anything less would be very poor policy. The buildings or tanks will be of brick or concrete and steel. Mr. Powell states that he will be here next month, before the work begins, with blue print plans showing the territory to be occupied by the mains. At this time he will be glad to have citizens examine the plans, and if any wish to have a main where none is now planned, to lay the matter before him so that if feasible the plans may be altered accordingly. This gas plant is something Owatonna has long needed, both for light and for fuel, especially the latter. The prices of coal and wood are so high in this part of the State that gas for cooking purposes will be a welcome relief. It will also be valuable for manufacturing purposes. Many will doubtless also prefer the softer light of gas to that of electricity. A gas plant is about the only thing lacking in Owatonna to make it a thoroughly equipped, up-to-date city."

The Empire Gas Improvement and Construction Company, of 49 Wall street, New York, has closed contracts with the Bellows Falls and North Walpole and the Springfield (Vt.) Gas Companies, for the entire construction of their plants, save as to mains and holders.

AT the annual meeting of the Brooklyn Borough Gas Company, which supplies the residents of Coney Island, the officers elected were: President, Richard L. Austin; Vice-President, Clayton E. Platt; Secretary, L. N. Spielberger; Treasurer, Robert Picken; Superintendent, J. J. Humphreys.

THE Asheville (N. C.) Electric Company, finding that its increased demand for the placing of gas stoves and the like has obliged it to make further provision for gas equipment, has bargained, or is bargaining for an additional storage holder.

WE understand that Mr. John E. Clarke, formerly in the employment of the Milwaukee Gas Light Company, has been appointed Superintendent of the commercial department of the Rockford (Ills.) Gas Light and Coke Company. Before leaving Milwaukee his fellow employees presented him with a diamond scarf pin, that he now looks upon with pride.

THE fire that occurred in the buildings of the Salisbury and Spencer Gas and Electric Company some days ago did less than $1,000 damage. Spencer is in North Carolina.

HOWELL, MICH., is to have a gas works. The franchise stipulates that the selling price shall not exceed $1.30 per 1,000 cubic feet.

THE Providence (R. I.) *Journal* notes that an act to incorporate the Kent County Gas Company has been introduced in the Rhode Island House of Representatives, by Mr. Woodmansee, of Warwick, and the measure was referred to the Committee on Corporations. The bill provides for a capitalization of $250,000, and authorizes the Company to manufacture and sell gas for light, heat and power in Warwick, Coventry and East Greenwich, the villages of Fiskeville, Jackson and Hope, and the towns of Cranston and Scituate, and to buy, sell and mortgage real and personal property in connection with the business. The right to construct works over or under highways and railroads is embodied, with the provision that work is to be done under the direction of the Town Council, and that 5 days' notice be given to the railroad in each case. The Company is to have a place of business in Warwick and is authorized to issue bonds, secured by a mortgage, on its franchise and other property, to an amount not exceeding its capital stock. The incorporators named are Edward E. Arnold, J. Ellery Hudson and Job S. Carpenter.

A CORRESPONDENT in San Francisco, Cal., writing under recent date, notes that Mr. E. F. Sullivan, Chief of the San Francisco Fire Department, recently received a letter from Mr. John A. Britton, President of the San Francisco Gas and Electric Company, inclosing a check for $5,000 as an expression of the appreciation the Company feels for the able work that was done by the Chief and his men on the night of February 22, when the Company's plant was badly damaged by fire. The money sent to the Chief is to be added to the benevolent fund of the department. A part of Mr. Britton's letter is follows:

"To the intrepid daring of yourself and men and to your coolness and able direction are due the fact that the fire did not assume larger proportions, and made it possible for the Company to begin operating a portion of its plant within the brief space of 48 hours."

AT the annual meeting of the shareholders in the Atlanta (Ga.) Gas Light Company, the officers chosen were: President, W. L. Cosgrove; Vice-President, P. S. Arkwright; Treasurer, G. W. Brice; Secretary, T. K. Glenn.

THE control in the shares of the Cape May Illuminating Company, of Cape May, N. J , has passed into the hands of those who likely will hereafter operate in harmony with the fortunes of the local electric lighting concern.

GENERAL FERDINAND C. LATROBE, Mayor of Baltimore for many years, and now President of the Consolidated Gas Company of that city, says he has no intension of resigning from the latter position to make a campaign for the mayoralty next year.

THEY are to have a gas company at Minot, N. D. It is to be known as the Minot Gas Light, Fuel and Power Company, and Mr. O. M. Pierce is the main promoter.

THE Stafford Springs (Conn.) gas and electric lighting plants were recently sold for $10 over the mortgage debt. The purchaser was Mr. W. T. Hincks, of Bridgeport, Conn., and in a short while details of the reorganization will be at hand.

MR. A. J. CUMMINGS, writing from Oakland, Cal., under date of the 10th inst., incloses the following: "Mr. F. A. Leach, Jr., Manager of the Oakland Gas, Light and Heat Company, announced the extent of the reduction the corporation had decided to make in the price of gas. Commencing May 1, fuel gas will be 90 cents per 1,000 feet instead of $1, the present charge, and illuminating gas will be $1.15 instead of $1.25. The statement that the Directors of the Company, following its usual policy, had determined to make a cut in the price of gas was published a few days ago, but at that time the amount of the reduction had not been decided upon. When the Company first began furnishing gas to the residents of Oakland, way back in 1867, the price was $7.50 per 1,000 feet. Voluntary reductions have been made from time to time since then, until the price which is to go into effect May 1 will be as low as in any other city on the Pacific Coast."

MR. J. M. BERKLEY, formerly engaged in the service of the Indianapolis (Ind.) Gas Company, under the late Mr. James Somerville, has been appointed chief operator of the gas division of the business of the Edison Electric Company, of Los Angeles, Cal., having supervision of all operation and distribution in its several gas plants located in Redlands, Colton, Riverside, Pomona, Santa Barbara, Whittier, Santa Ana, Santa Monica, San Pedro, Long Beach and Mourovia.

MR. C. E. PAIGE, Superintendent of the Malden and Melrose (Mass.) Gas Light Company, writing to us under date of the 21st inst., says that they have organized a body from their workmen called an "Improvement Class," the object of which is to instruct and assist the employees. The class meets every week and discusses 5 questions that were selected from those deposited in a question box the previous meeting. Mr. Paige asks for knowledge respecting the practices governing other kindred bodies, and we hope and believe this publicity will bring him the desired results. We know that similar associations exist in New York, Hartford, Milwaukee and Denver, and we have no doubt that those in control thereof will be glad to let Mr. Paige and his associates know all they know about their organization on request, or perhaps voluntarily. He can be addressed at the works' office of the Malden and Melrose Gas Light Company, Malden, Mass.

THE Directors of the East Boston (Mass.) Gas Light Company have declared the regular quarterly dividend of 2½ per cent., payable the 31st inst.

The True Meaning of Electric Meter Rates.

Electricity notes that the true meaning of meter rates lies deeper down than the mere question of being accommodated with a rate that seems satisfactory at the moment. The charges made by electric light and power companies, and the least possible charge that could reasonably be made, are the features that loom up in all their importance when the vital and more fundamental points are considered. A review of the details that circumscribe the question in general are more apt to subtract from the value of any argument than to add to it. For this reason it is not essential to consider anything but the pivotal question around which it seems all other questions revolve. But what is the central consideration, and how may it be intelligently regarded in the light of the question at present at issue? It may be stated that this most important of all considerations in connection with the meter rate is the loss in cash a company sustains when it charges too much. It seems paradoxical, but it is still strictly true, that in the case of all relationships between a company and the public, it is the price or rate which either makes or destroys confidence between them, by a charge which either builds up a company's business rapidly, or holds it, so to speak, in *statu quo*. The vital mistake, therefore, which consumes time and money, is that of a concern intrusted with a franchise not taking the logical view, that after all the price it sets for its commodity is for its own benefit primarily. It may believe a high price protects its interests better, but this fallacy has been exploded time and again in a variety of instances.

The true meaning of meter rates, with the huge army of consumers increasing every day, is that of a large profit at a low price. Nothing so attracts the public as this, and nothing will so surely develop a belief in fair play, low cost, and necessary utilization of the current, as the idea that it is for all of them and not alone for a favored or fortunate class, a little richer than the great majority.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 42 Pine Street, New York.
Telephone, 2996 John.

TERMS:

SUBSCRIPTION—Three Dollars per annum, in advance. Single copies, 10 cents.

MONDAY, MARCH 26, 1906.

The Market for Gas Securities.

The market for city gas shares is really no market. There cannot be any doubt that 80-cent gas is to go, and there cannot be any greater doubt that the gas made and sold in New York city will not be quite as good hereafter as it was before—New York city for many years enjoyed the distinction of getting the best gas that was made and sold in the world. However, it is up to the Legislature and to the Commission, and between them it rests. The quoted prices for Brooklyn Union are ridiculous. The cut in dividend rates may not cause much blood to those who hold on.

The out-of-town shares are strong, notably Washington, D. C., where one may look for some shift in the capitalization at any time. Gas bonds of all sorts seem to be in good demand.

Gas Stocks.

Quotations by George W. Cloose, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

MARCH 26.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	145⅛	145¼
Central Union, Bonds, 5's	3,000,000	1,000	108	110
Equitable Bonds, 6's	1,000,000	1,000	..	105
" 1st Con. 5's	2,300,000	1 000	118	120
Mutual	3,500,000	100	255	270
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	105	107
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	98	104
Northern Union, Bonds, 5's	1,250,000	1,000	105	107
New York and East River .. Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000	..	104	110
Standard	5,000,000	100	140	160
Preferred	5,000,000	100	165	175
Bonds, 1st Mortgage, 5's	1,500,000	1,000	111	114
Yonkers	999,550	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	128⅝	130
" " Bonds (5's)	15 000,000	1,000	112	113
Bay State	50,000,000	50	⅜	..
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	65
" 1st Mtg. 5's	509,000	1,000	95	100
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
d " " "	3,000.000	1.000	47¼	50
Buffalo City Gas Co.	5,500,000	100	10	12
" " Bonds, 5's	5,250,000	1,000	75	80
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	106½
Cincinnati Gas and Electric Co	29,500,000	100	103¾	103
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	90	..
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	..	95
Preferred	3,026,500	100	107½	108
Consumers, Toronto	,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	85	87
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	..	..	100
Detroit City Gas Co	5,000,000	50	..	50
" Prior Lien 5's	4,618,000	1,000	..	98
Detroit Gas Co., 5's	381,000	1,000	75	80
" Inc. 5's	16,000	100	98⅛	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
For Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	110	112
" Bonds, 5's	10,500,000	..	107½	108¼
Indianapolis	2,000,000	..	60	70
" Bonds, 5's	2,650,000	..	104½	105
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,823,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	.	105
Preferred	2,500,000	100	95	110
Bonds	10,000,000	1,000	108½	109
Lafayette Gas Co., Ind	1,000,000	100	..	60
Bonds	),000,000	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	106	108¾
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	218¾
Nashville Gas Lt. Co	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	5,000,000	..	56	58
Bonds, 6's	5,0(0,000	..	137	138
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	94⅛	94⅝
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	..
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	104⅛	105¼
San Francisco, Cal	15,800,000	00	58⅛	58¾
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	92	..
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	96¼	..
Syracuse, N. Y.	1,975,000	100	50	55
Bonds	2,047 000	1,000	102	..
Washington, D. C	2,600,000	20	300⅝	302½
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	..	..	..
Wilmington, Del	600.000	50	230	..

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., N. W. CORNER BROAD AND ARCH STS., PHILADELPHIA, PA., March 14, 1906.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable April 14th, 1906, to stockholders of record at the close of business, March 31, 1906. Checks will be mailed.

1606-4 LEWIS LILLIE, Treasurer.

SEALED PROPOSALS.

DEPARTMENT OF PUBLIC WORKS, BUREAU OF LIGHTING OFFICE, ROOM 334, CITY HALL, PHILADELPHIA, March 19th, 1906.

Sealed proposals, indorsed, "Bids for lighting the incandescent naphtha lamps and furnishing lamp posts in the city of Philadelphia," and addressed to the undersigned, at the office above mentioned, will be received until 12 o'clock, noon, on April 3, 1906, for lighting the incandescent naphtha lamps and furnishing lamp posts in the city of Philadelphia during the year 1907.

Specifications, information and blank forms upon which bids must be made can be obtained at the office of the Bureau of Lighting, Room 334, City Hall.

This advertisement is made and contract will be awarded subject to an appropriation to be made by City Councils.

No bid will be considered unless accompanied by a certificate from the City Solicitor that the provisions of an ordinance requiring proposal bonds when the bids exceed in amount $500, approved May 25, 1869 (p. 81, West), have been complied with.

The Director reserves to himself the right to reject any or all bids as he may deem best for the interests of the city.

1607-1 THOMAS L. HICKS, Director.

NOTICE!

PLEASE read the advertisement of the Empire Gas Improvement and Construction Company, on page 553. This Company employs only high-priced and quick-working mechanics, and all its work is guaranteed to be strictly first class, and will be finished at time specified. A. M. SUTHERLAND,

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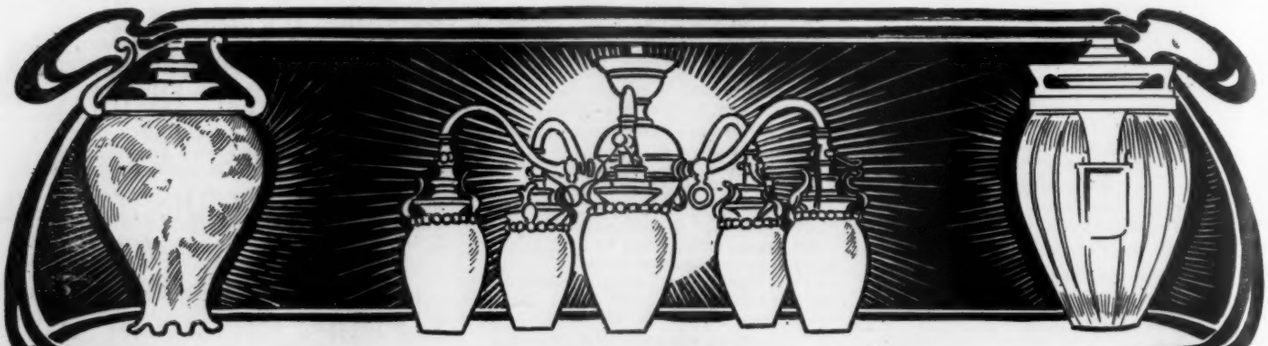

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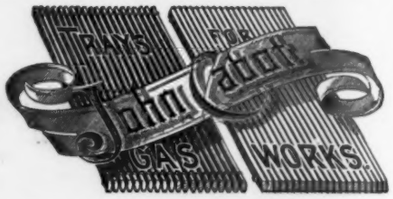

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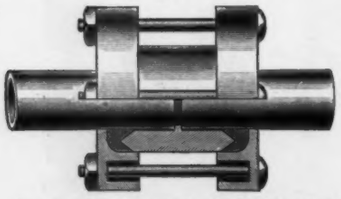
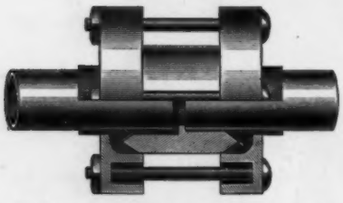
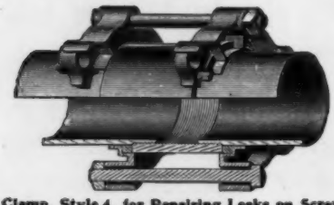
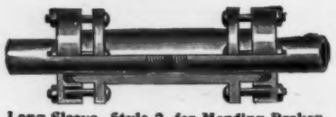

Regular Coupling, Style 1, for Plain End Wrought Iron Pipe.


Insulating Coupling, Style 5, for Plain End Wrought Iron Pipe,


Clamp, Style 4, for Repairing Leaks on Screw Collar.


Long Sleeve, Style 2, for Mending Broken Lines.

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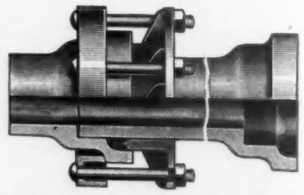
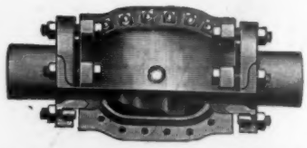
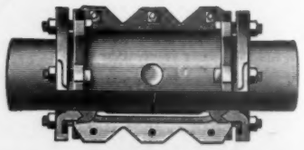
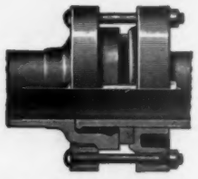

Coupling, Style 9, for Special Style Cast Iron Pipe.


Split Sleeve for Repairing Broken Bell on Cast Iron Pipe.


Split Sleeve for Repairing Broken or Cracked Cast-Iron Pipe.


Clamp, Style 4½, for Repairing Leaky Lead or Cement Joints in Cast Iron Pipe.

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" 1	34.00	¾ "	2	31 "	10¾ "	62 "
Contact 6	23.00	¾ "	3	29¼ "	12 "	60 "
" 8	23.50	½ "	3½	28¼ "	10¾ "	48 "
" 9	20.00	⅜ "	1	24 "	9¼ "	45 "

These prices include Safety Valves and Unions, one Bent Output Spout. For prices of fittings see our complete catalogue, "The Luxury of a Bath."

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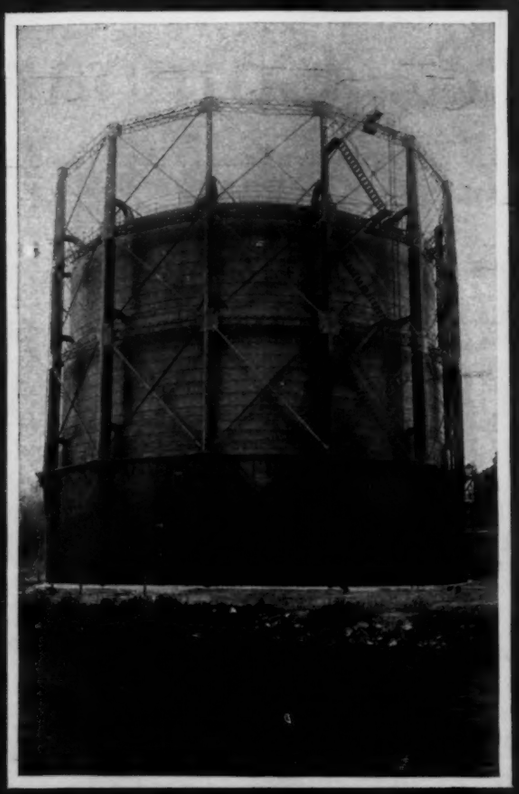

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Stand so High in the estimation of those using them?

THE ANSWER IS IN THREE WORDS:

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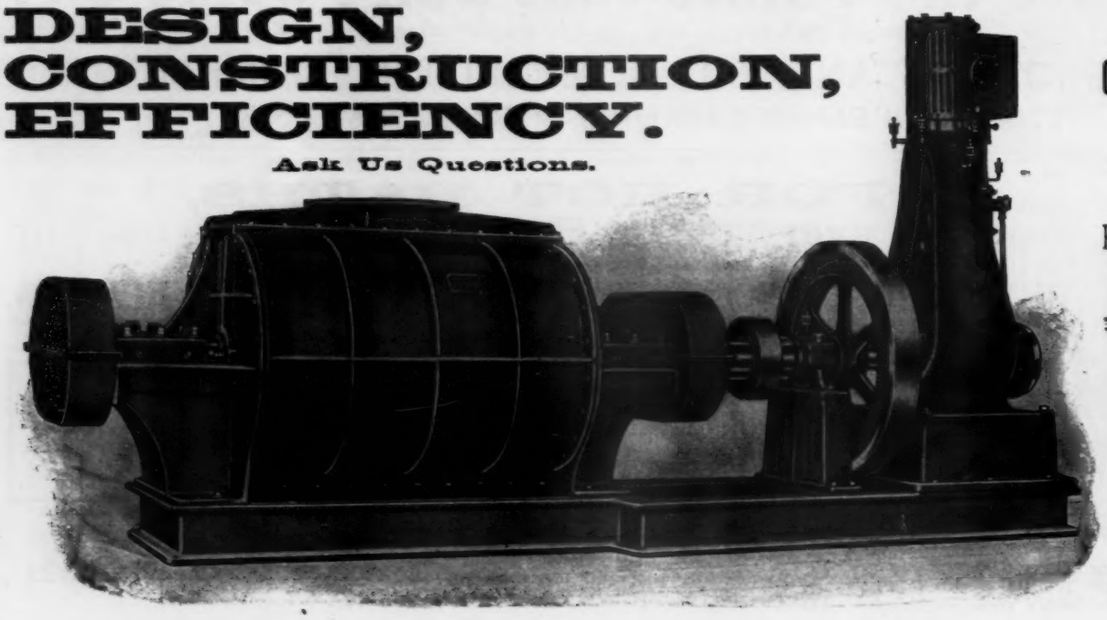

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Houses, specially designed for room and economy.
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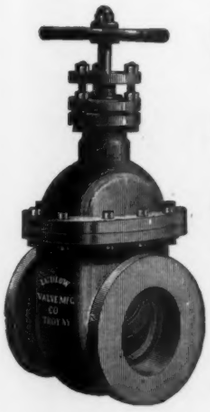

Double and Single Gate Valves, ¼" to 72",

—FOR—

Gas, Water, Steam, Oil, Ammonia, Etc.

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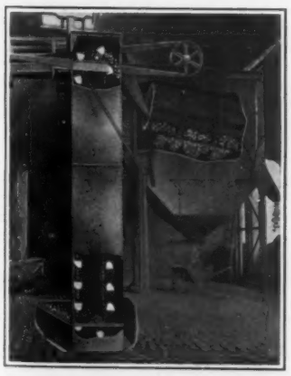

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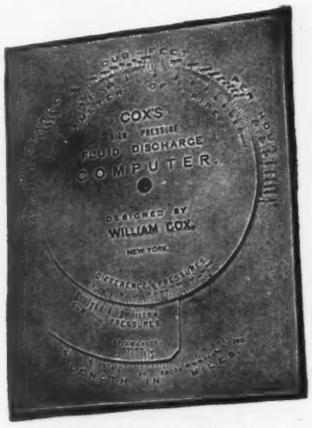

This Computer solves the following formula, which is applicable to Gas, Air and other elastic fluids, flowing through long pipes with high initial pressures:

Discharge in cubic feet per hour at atmospheric pressure $= 33.3 \sqrt{\frac{d^5 \times (p_1^2 - p_2^2)}{L \times w}}$

Where
d = diameter of pipe in inches,
p_1 = absolute initial pressure in pounds per square inch,
p_2 = absolute terminal pressure in pounds per square inch,
L = length of pipe in miles,
w = specific gravity of the fluid when air = 1.

To Find the Discharge from a Pipe and the Required Size of Pipe.

(1.) Set the specific gravity of the fluid opposite the length of pipe;

(2.) Bring the DIFFERENCE of the initial and terminal gauge pressures opposite the SUM of the initial and terminal gauge pressures;

(3.) Opposite any diameter of pipe will now be found the discharge in cubic feet per hour at atmospheric pressure; and

(4.) Opposite any desired discharge will also be found the required diameter of pipe.

Price of the Computers, in Cloth Case, 6½ x 8 inches, $5 Each, Net.

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Stock sizes: ½, 1 and 2-ton capacity.

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That your retorts carry none of the weight of your mouthpieces?
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MUELLER COMBINATION MACHINE NO. 14.

C—1002.

Tapping a gas main is heavy work at best, and a machine that won't stand a little rough handling won't last long at it.

Mueller Gas Tapping Machines have strong chains and stays for holding them to the pipe. the uprights are large and heavy enough to stand the general strain of tapping or handling, and the ratchet and parts are made of a grade oi steel that will resist any torsion or stress resulting from the use of large or dull tools. They can be counted on to last a number of years.

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what size of pipe to use to convey any quantity of gas, any distance, with any loss of pressure and any initial or final pressure? Then use

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as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

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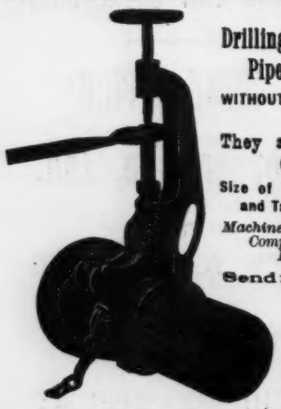

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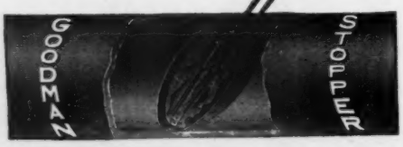
Any size gas main can be shut off in 30 seconds. : : :



Temporarily during alterations and repairs. : : : :

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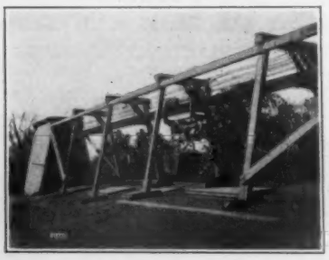
Installed for Jacksonville (Ill.) Gas Light and Power Company.



Telpher travels with coal-filled bucket from storage bin to boiler room, where it is automatically dumped. Then reversing itself, it returns with empty bucket for another load.

Conveying speed is 250 feet a minute and the hoisting capacity one ton at 60 feet a minute.

All kinds of materials can be transported by Telpherage.

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OPEN TOP CARRIER.

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Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

APRIL, 1906.

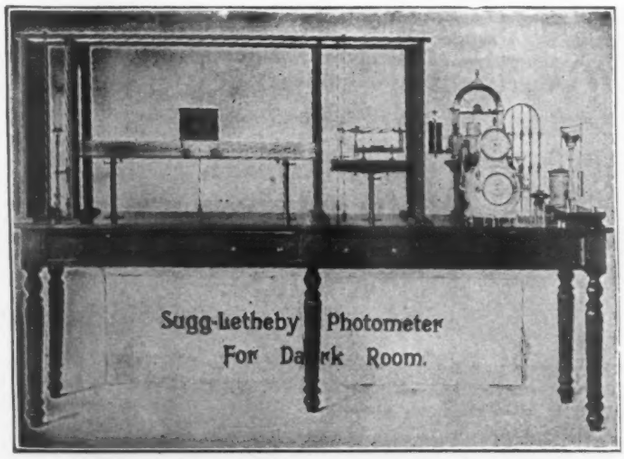
Table No. 1.
FOLLOWING THE MOON.

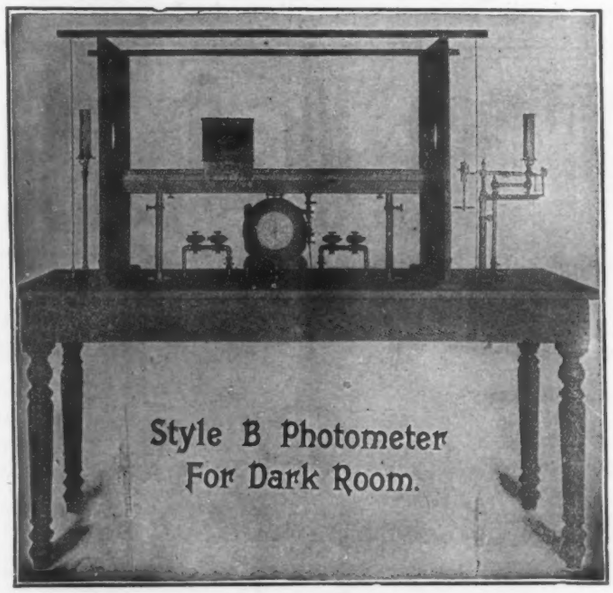
Day of Week.	Date.	Light.	Extinguish.
Sun.	1	12.30 AM Fq	4.40 AM
Mon.	2	1.10	4.40
Tue.	3	2.00	4.40
Wed	4	2.40	4.40
Thu.	5	3 20	4.40
Fri.	6	3.50	4.40
Sat.	7	No L.	No L.
Sun.	8	No L PM	No L.
Mon.	9	No L.	No L.
Tue.	10	7.00 PM	9.20 PM
Wed.	11	7.00	10.40
Thu.	12	7.00	11.50
Fri	13	7.00	12.50 AM
Sat.	14	7.00	1.50
Sun	15	7.10 LQ	2.40
Mon.	16	7.10	3.20
Tue.	17	7.10	4.00
Wed.	18	7.10	4.20
Thu.	19	7.10	4.20
Fri.	20	7.10	4.20
Sat.	21	7.10	4.20
Sun.	22	7.20	4.10
Mon.	23	7.20 NM	4.10
Tue.	24	7.20	4.10
Wed.	25	7.20	4.10
Thu.	26	7.20	4.10
Fri.	27	7.20	4.10
Sat.	28	10.20	4.10
Sun.	29	11.10	4.00
Mon.	30	11 50	4.00

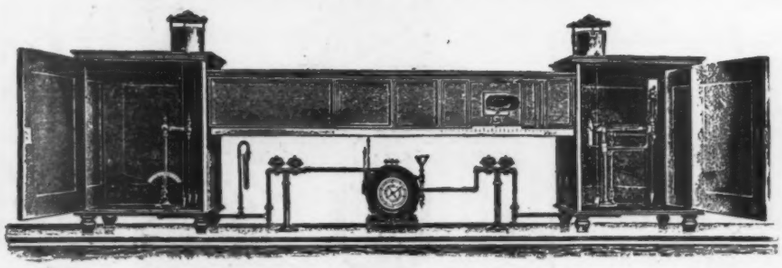
TOTAL HOURS DURING 1906.

By Table No. 1.

	Hrs.Min.
January	223.40
February	190.40
March	192.10
April	167.00
May	152.20
June	142.10
July	150.20
August	157.40
September	170.00
October	185.10
November	201.40
December	214.00
Total, yr.	2146.50







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

APRIL, 1906.

Table No. 2.
NEW YORK CITY.
ALL NIGHT LIGHTING.

Day of Week.	Date.	Light	Extinguish.
		P. M.	A.M.
Sun.	1	6.10	4.55
Mon.	2	6.15	4.40
Tue.	3	6.15	4.40
Wed.	4	6.15	4.40
Thu.	5	6.15	4.40
Fri.	6	6.15	4.40
Sat.	7	6.15	4.40
Sun.	8	6.15	4.40
Mon.	9	6.25	4.30
Tue.	10	6.25	4.30
Wed.	11	6.25	4.30
Thu.	12	6.25	4.30
Fri.	13	6.25	4.30
Sat.	14	6.25	4.30
Sun.	15	6.25	4.30
Mon.	16	6.30	4.20
Tue.	17	6.30	4.20
Wed.	18	6.30	4.20
Thu.	19	6.30	4.20
Fri.	20	6.30	4.20
Sat.	21	6 30	4.20
Sun.	22	6.30	4.20
Mon.	23	6.40	4.10
Tue.	24	6.40	4.10
Wed.	25	6.40	4.10
Thu.	26	6.40	4.10
Fri.	27	6.40	4.10
Sat.	28	6.40	4.10
Sun.	29	6.40	4.10
Mon.	30	6.45	4.00

TOTAL HOURS DURING 1906.

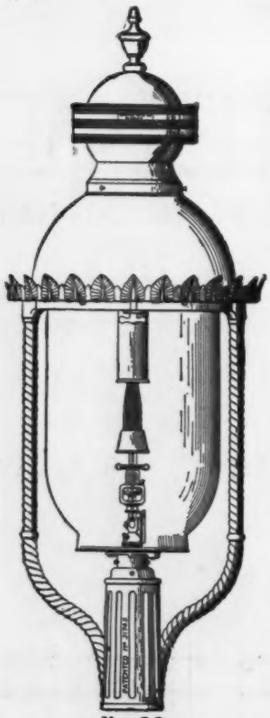
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 318 West 42d Street. BOSTON, 820 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, 218 La Salle Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

The Welsbach No. 6 Harp Fixture.

AN IDEAL LIGHT FOR DINING OR LIVING ROOMS.

THE HIGHEST MECHANICAL INGENUITY COMBINED WITH ORNAMENTAL BEAUTY--THE NEWEST OUTPUT FROM THE WELSBACH FACTORIES.

Equipped with new model No. 66 high candle power Welsbach Burner.

Side Pilot By-pass Tube covered with refractory sleeve to prevent bending.

Fourteen-inch Opal Dome Shade.

Polished Brass Embossed Crown 2¼ inches high.

Length of Fixture, 30 inches.

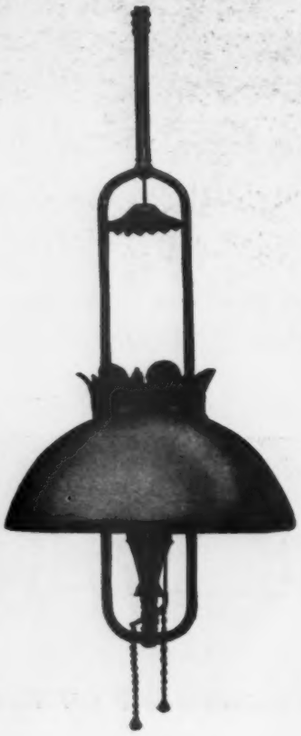
Width of Harp, 4½ inches.

Finished in Polished Brass.

Packed One Dozen to the Case.

List Price, per Dozen, $45 00.

We recommend equipping the No. 6 Harp Fixture with No. 4197 Intensive Brand Mantle, and the No. 306 **F. Q. M.** Clear Glass Air-Hole Cylinder.



Although the 14-inch Opal Dome Shade is standard equipment, we are prepared to furnish Dome Shades in green, pink or yellow (opal lined), and will be glad to quote prices.

WELSBACH CO.,

Salesrooms in all the principal cities of the United States.

Factories:

GLOUCESTER, N. J.
CHICAGO, ILL.

THE UNITED GAS IMPROVEMENT COMPANY

For the Year Ending December 31st, 1905, has been Awarded Contracts for 40 Sets of

Standard Double-Superheater Lowe Water Gas Apparatus.

PARTIAL LIST OF PLACES:

Catasauqua, Pa.
Plattsmouth, Neb.
Detroit, Mich. (2d contract).
Springfield, Ills.
Oneonta, N. Y. (2d contract).
Pottsville, Pa. (2d contract).
Evansville, Ind. (2d contract).
Lansdale, Pa.
Hempstead, N. Y. (2d contract).
New Britain, Conn.
New York, Mutual Co. (3d contract)
St. Louis, Mo. (4th contract).
Sioux City, Ia. (3d contract).
Amsterdam, N. Y.
Houston, Tex. (2d contract).
Hamilton, O. (2d contract).
Indianapolis, Ind. (2d contract).
Nanticoke, Pa.
Hazleton, Pa.
Mahanoy City, Pa.
Ludington, Mich.
Ossining, N. Y.
Lancaster, Pa.
Flushing, N. Y. (2d contract).
South Bend, Ind.
Fall River, Mass. (2d contract).
Minneapolis, Minn. (2d contract).

TOTAL SETS TO DECEMBER 31, 1905, ... 593
TOTAL DAILY CAPACITY TO DECEMBER 31, 1905, 463,780,000 CU. FT.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

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FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

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FLEMMING GENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

OFFICE AND WORKS:
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An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the 36th year of publication. Compiled and arranged by JOHN W. FIELD, Sec'y and Gen. Mgr. of The Gas Light and Coke Company, London. Price, $5. For Sale by

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Manhattan Fire Brick and Enameled Fire Clay Retort Works.

Works at Weber, on the Raritan River, Middlesex County, New Jersey.

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Modern Coal Gas Benches,

With either Horizontal or Inclined Retorts, Half-Depth and Full-Depth Recuperative Furnaces.

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STANDARD BENCH IRONWORK.

Linings for Water Gas Apparatus, High Grade Fire Brick of All Shapes and Sizes, Ground Fire Clay, Ground Fire Brick in Bulk or in Barrels.

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BENCH SETTINGS,

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In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

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All styles of which we have in operation, equipped with the BEST of LATEST IMPROVEMENTS, proving our claim for SUPERIOR QUALITY and EFFICIENCY.

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Labor-Saving Machines for Handling Coal and Coke from Coal Cars to Coke Yard or Bins, a Specialty.

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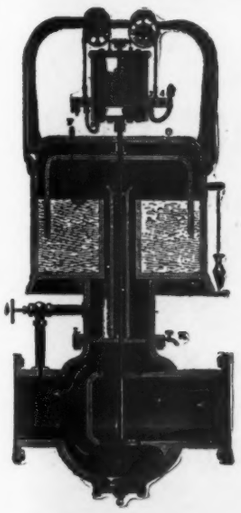

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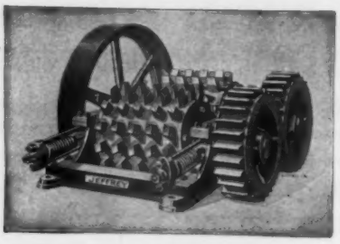

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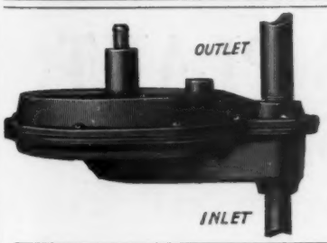

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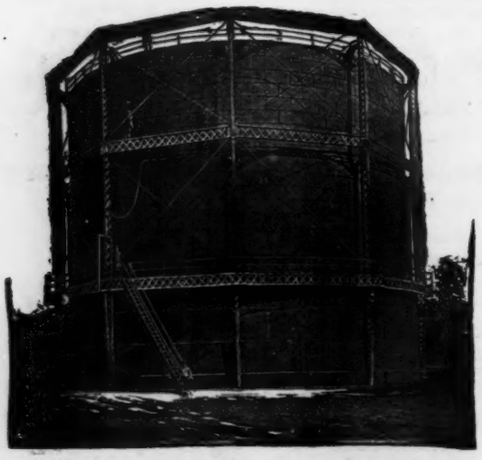

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Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

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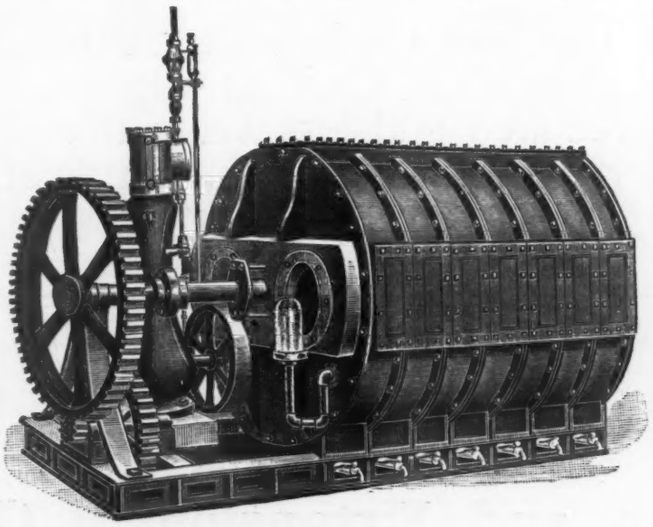

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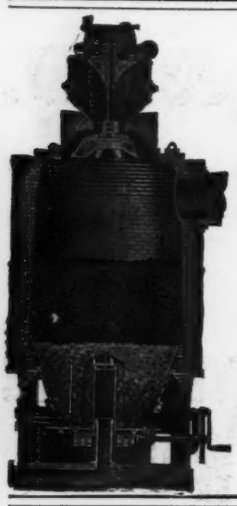

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Size.	8 Inches.	10 Inches.	12 Inches	16 Inches.	20 Inches.	24 Inches	30 Inches.	36 Inches.
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Directory of American Gas Companies, 1905.

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GASHOLDERS AND STEEL TANKS

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And All Ironwork and Apparatus Required in a Gas Plant.

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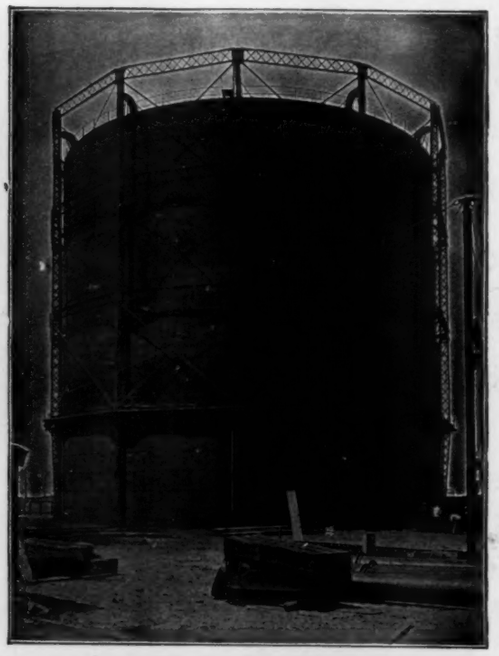

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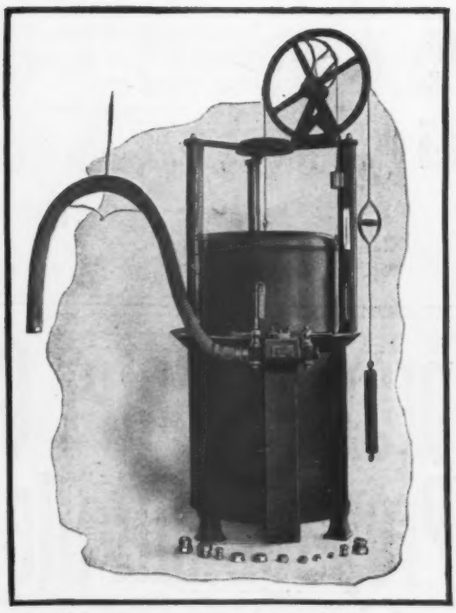

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EXCERPTS FROM DECISIONS

—OF THE—

BOARD OF GAS COMMISSIONERS of the COMMONWEALTH OF MASSACHUSETTS.

MR. E. H. YORKE, NEW HAVEN, CONN., Dec. 1, 1898.

Dear Sir: I am in receipt of a copy of "Excerpts from the Decisions of the Board of Gas Commissioners," which is a handy compilation in book form of extracts from the most recent decisions of the Gas Commission of Massachusetts.

I note that most of these extracts are broad and safe-guiding precepts, which apply with equal force to one Company as to another. The 13 years' existence of the Board of Gas Commissioners, with its unusual opportunities for acquiring information, have justly made it a high and safe authority in all matters pertaining to the management, obligations and rights of Gas Companies. Your little book will serve as a valuable reference library in settling legal complications which often arise between a Gas Company and its customers.

Yours truly, (Signed) F. C. SHERMAN, Superintendent.

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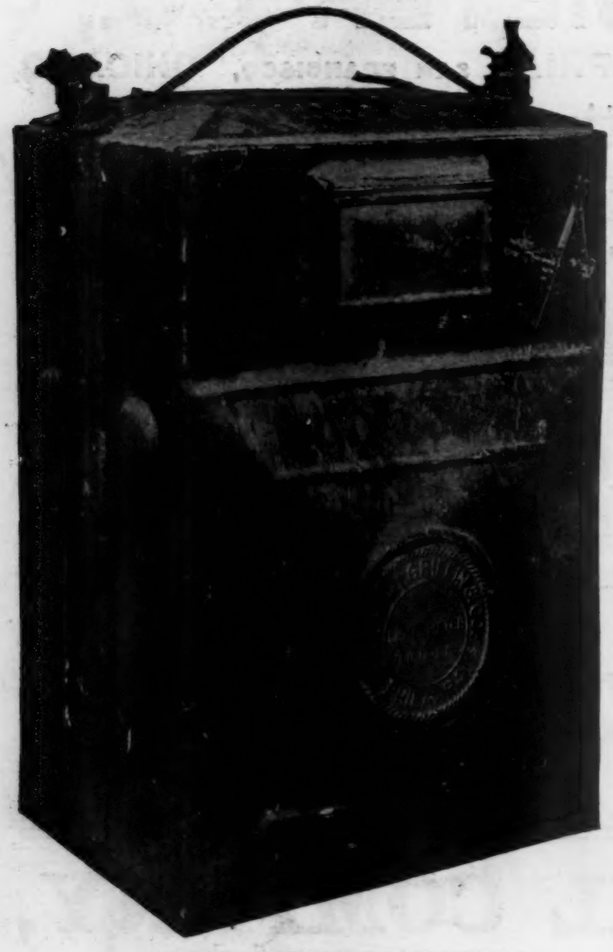

This is a photograph of a 3-light regular meter out of a lot of meters received from the Coatesville Gas Co., Coatesville, Pa., to be repaired and converted into prepayment meters.

AFTER.

This is the same meter after it has been repaired and converted into a new prepayment meter.

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